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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Twenty-third Annual Meeting, American Gas Light Association.

OFFICE OF THE SECRETARY, P. O. Box 1160,
PROVIDENCE, R. I., September 5th, 1895.

The 23d annual meeting of the American Gas Light Association will be held in the city of Philadelphia, Pa., on October 16th, 17th and 18th, 1895.

The sessions will be held at Association Hall, on Chestnut street. The following papers will be read:

"The Creation of a Healthy Public Sentiment Toward the Gas Company in the Locality in which it Operates," by Mr. W. H. Rogers, Paterson, N. J.

"Retort House Design and Practice," by Mr. A. E. Forstall, Newark, N. J.

"Notes on the Storage of Oil at Gas Works," by Mr. Frederic Egner, Norfolk, Va.

"The Ventilation of Gas Lighted Rooms," by Mr. Irvin Butterworth, Columbus, O.

"Bench Firing with Soft Coal," by Mr. E. G. Pratt, Des Moines, Ia.

One other paper was promised, but the serious illness of the author has delayed its preparation, so that it is now doubtful whether it can be prepared.

Reduced rates for transportation are being arranged for and undoubtedly will be secured. Further information will be given in a general circular which will soon be issued to all the members.

Applications for membership must be indorsed by two active members and be received by the Secretary on or before October 5th, as if received later than that they cannot be constitutionally acted upon at this next meeting. Write to the Secretary for blanks and full information.

Questions for the Question Box should be sent to the Secretary as early as possible, as each one will be referred to some member, who will lead discussion on it, and so it is very desirable that sufficient time be given for proper investigation of the subjects.

In a few days the Secretary will send out the annual due bills, and it is hoped that the members will make their remittances promptly, by check or postal money order, payable to the American Gas Light Association, and not leave the matter till the meeting, as the collection of dues at that time causes very much hard work for the Secretary, which could be to a large extent avoided if remittances were sent by mail.

The Committee of Arrangements are busily engaged in the preparations for the meeting, and further notice will be given as the details of the programme are finally decided upon.

Respectfully, A. B. SLATER, JR., Secretary.

[OFFICIAL NOTICE.]

September Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, August 29th, 1895.

The September meeting of the Society of Gas Lighting will be held at the Arena, No. 39 East 31st street, New York, on Thursday, the 12th inst., at 3 P.M.

FRED. S. BENSON, Secretary.

BRIEFLY TOLD.

OPPOSED TO A CONCERTED EXHIBITION OF GAS APPLIANCES.—Last week we reprinted a circular, prepared by and issued under the direction of the Committee of Arrangements for the '95 meeting of the American Gas Light Association, which called for a positive expression of opinion from those who received it as to whether, in the receiver's judgment, a concerted exhibition of gas appliances at the Philadelphia meeting of the American Association would be in the line of good policy or

not. In brief comment on the lines of the circular we gave our answer, which was unreservedly in the affirmative, being led to that conclusion from the certain knowledge that nothing other than good to the exhibitors and to the inspectors of the exhibits could result from such an exhibition. Nor is there any undue positiveness in the remark that our knowledge in this respect is certain, since in the past we have had inquiries, from those who looked over and through exhibitions of the nature proposed—exhibitions, too, that were seemingly quite meager, if not sparse—respecting some particular appliance on show, the general feature of which remained in the inquirer's mind, while the details thereof were indistinct to him, the inquiries being made months after the display was ended. In fact, what we would attempt to prove, keeping in mind the rush and glitter which attend the progress of a convention of the usual type, is that gas appliance exhibitions, whether they are held in connection with an Association meeting or even as an adjunct, say, to a demonstration lecture by a single gas company on the merits of gas for cooking or heating, are in the long run fruitful of results; for the onlooker, when he returns to his field of ordinary work, oftentimes encounters a condition the perplexity of which may be solved to his and his customer's satisfaction through the agency of something that the former saw at the gas appliance exhibition, at——, in——? However, the Committee of Arrangements for the current meeting have appealed to the representative makers of gas appliances, in a manner straightforward and impartial, as per their circular of last August, and we are unfortunately compelled to report that the answers to their inquiries were in the negative by a large majority. This result of their interrogatories puts a concerted exhibition under the auspices of the Committee out of court; but there still remains a ray of hope in the knowledge, and we say so advisedly, that even a "disconcerted" exhibition may be made, the participators in which may count to any reasonable extent on the help of the Committee to assist them in putting their wares before the visitors in a fashion that will be acceptable to those who will be in Philadelphia in October next anxious to note what advances in gas cookers and heaters have been brought about by the designers thereof during the "slow season." To us it looks that the manufacturers of this class of goods, even though the manufacturers thereof need not necessarily be of the greatest "popular fame," should be able to make a pretty good "disconcerted" exhibition. Mr. F. H. Shelton, Chairman of the Committee of Arrangements, Drexel Building (Room 813), Philadelphia, Pa., will attend to any inquiry on the exhibition account.

THE CONSOLIDATION SCHEME AT NEWARK, N. J., IS ACCOMPLISHED.—The combination of the gas interests of Newark has been perfected, according to the scheme the details of which have heretofore been made known in the JOURNAL. The capitalization of the new concern has been adjusted at $5,000,000—$4,000,000 of bonds and $1,000,000 preferred stock. The officers named are: Directors, Stephen H. Condict, George B. Jenkinson, John L. Blake, Chas. A. Lighthipe, Henry C. Kelsey, George E. Halsey, E. L. Joy, Henry Powles and Andrew Kirkpatrick; President, John L. Blake; Vice-President, Stephen H. Condict; Secretary, Clarence L. Nelson; Treasurer, Robert B. Hathorn. The Trustees on behalf of the bondholders are Messrs. Eugene Vanderpool, Marcus L. Ward and Andrew Kirkpatrick. It is not at all unlikely that some change in this list will be made at the annual meeting of the Citizens Company, which takes place next February; for the Citizens Company virtually controls the merged Company, through its holding in the stock securities thereof. It is useless to express here regrets at the changed condition of gas affairs in New Jersey's greatest city, since the proprietors of such interests know, and know to the letter, how best to further them; still it remains the simple fact that the old Newark Company, with its record for probity and courage, is not singly of itself to-day.

NOTES.—Press despatches, dated the 4th inst., bring the news of a distressing accident on the works of the Providence (R. I.) Gas Company, through which five workmen lost their lives. The details are so mixed that it is only certain to say now that they were asphyxiated by escaping gas. We hope next week to have an authenticated account of the unfortunate happening.——Mr. L. H. Humphrey has been elected to the vacancy in the Board of Directors of the Warsaw (N. Y.) Gas Light Company occasioned by the death of Mr. Augustus Frank.——We are not over-addicted to parading the worth that is of us, but we cannot forbear from repeating the following, just to hand, from Mr. C. H. Dale, President of the Peerless Rubber Manufacturing Company, of this city: "We are very much pleased with the results of our advertisement in your JOURNAL; in fact, the results have been very flattering indeed."

On the Illuminating Value of the Various Constituents of Coal and Oil Gas, and the Conditions Necessary to Produce Incandescence.

[A lecture delivered by Prof. W. Ivison Macadam before the North of Ireland Association of Gas Managers.]

The subject which I have chosen for my lecture to you is one which is at the present time receiving very considerable attention; and the theories advanced are so widely different, that it becomes a matter of difficulty to follow the many workers.

The substances present in illuminating gas, whether made from coal or oil, may roughly be said to be methane or marsh gas, unsaturated hydrocarbons of the olefiant gas type, a small proportion of benzol type bodies, the two oxides of carbon (carbonic anhydride and carbonic acid and carbon monoxide), hydrogen, oxygen and nitrogen, etc. Of these bodies, nitrogen and carbonic anhydride are not combustible; carbon monoxide and hydrogen give non-luminous flames, and the remaining substances are combustible, yielding more or less luminous flames. The proportion in which these substances are present varies greatly. The unsaturated hydrocarbons, for instance, may be present in oil gas to the extent of from 20 to 40 per cent.; while in coal gas the proportion may fall as low as 5 to 10 per cent., or in some few cases run up to 15 or 18 per cent.

As illustrating the composition of coal gas, I quote the following analysis:

London Gas (Thwaite).

	Per Cent.
Unsaturated hydrocarbons	3.84
Benzol	1.04
Marsh gas	35.63
Carbonic anhydride	1.41
Carbon monoxide	6.15
Hydrogen	47.73
Oxygen	0.30
Nitrogen	3.90
	100.00

This gas would probably run about 12-candle power for each 5 cubic feet. Of course, these figures vary greatly with the coal employed in its manufacture, as will be seen from the following analysis of London gas of 12 and 20-candle power:

London Gas.[1]

	12-Candle Power.	20-Candle Power.
Unsaturated hydrocarbons, etc	3.8	13.0
Marsh gas	39.5	50.0
Carbonic anhydride	0.6	0.1
Carbon monoxide	7.5	6.8
Hydrogen	46.0	27.7
Oxygen	0.1	0.0
Nitrogen	0.5	0.4
Moisture	2.0	2.0
	100.0	100.0

The temperature at which the coal has been retorted also alters the composition as well as the yield of the gas. This is shown in the following table, given in "Thorpe's Dictionary of Applied Chemistry":

Newcastle Coal.

Gas per ton of coal, cubic feet	8,250	9,692	12,006
Illuminating power, candles	20.59	17.80	15.60
	Per Cent.	Per Cent.	Per Cent.
Unsaturated hydrocarbons	7.55	5.83	4.51
Marsh gas	42.72	34.50	30.70
Carbon monoxide	8.72	13.50	13.96
Hydrogen	38.09	43.77	48.02
Nitrogen	2.92	2.40	2.81

These results are perhaps better understood when they are calculated to the cubic foot of each gas produced per ton of coal. They are:

Unsaturated hydrocarbons	622.9	565.1	541.5
Marsh gas	3,524.4	3,344.1	3,685.8
Carbon monoxide	719.4	1,211.6	1,676.0
Hydrogen	3,142.4	4,242.6	5,765.3
Nitrogen	240.9	329.6	337.4

Lewes gives the following lighting value of various carbon and hydrogen compounds per 5 cubic feet burned:

1. "Chemistry as Applied to the Arts and Manufactures," Mackenzie.

Marsh gas	5.2	candle power.
Ethane	35.7	"
Propane	56.7	"
Olefine	70.0	"
Propene	123.0	"
Acetylene	240.0	"

These results, while comparative, are not those obtained in every case, but will vary with the apparatus employed as a burner. Thus, 5 cubic feet of the same gas have yielded me from 25-candle power to 61.95-candle power.

The pressure at which the gas is passed to the burner is one of the most important factors in deciding the illuminating value obtained from the gas. Thus, 5 cubic feet of a gas gave me, when burned at 18-10ths pressure, only 11.14-candle power; while the same gas, from the same burner, at 5-10ths pressure, gave 20-candle power. The effect of pressure has long been recognized by burner manufacturers; and it has been very fully worked up by Mr. Hislop, of Paisley, and others. The various devices employed to this end are well known. They consist of double burners, end to end, choked by gauze discs; and, best of all, by means of regulators attached to each burner. The older double burners were not choked, and the two burners were generally of the same bore. Now the burners are both choked, and the lower burner is very much smaller in bore than the upper. This device lowers the pressure at the point of ignition, and greatly increases the luminous value of the gas. Of the regulator burners, the best I know are those made by Messrs. Peebles & Co., of Edinburgh. They are necessarily dearer than the simple varieties, but the regularity of consumption and light value fully repays the increased cost.

When we desire to consider the changes which occur in the composition of the gas during combustion, we enter a more difficult field. The light obtained may be due to substances contained in the gas itself, or it may be due to a foreign body introduced into the flame. In this last case, the gas is mixed with air before combustion, so as to produce a non-luminous flame; and this is then allowed to impinge on the body to be rendered incandescent, while certain substances which, when burned under ordinary conditions, yield non-luminous or nearly non-luminous flames, may be made to give luminous flames by subjecting them to pressure. It is generally accepted that luminosity is usually due to the presence of solid particles in the flames, which, when heated, give off light. Professor Frankland has, however, shown that it is possible to obtain light from heated dense hydrocarbons; but we shall wait for further experimental proof before accepting the theory that the luminosity of coal gas is due to this cause.

The general explanation given in text books as to the changes taking place in an ordinary flame is that there are three distinct zones—the first or inner zone, largely caused by the pressure of the issuing gas, and consisting of unburned gas; the second, or luminous zone, in which the hydrogen is burned into water, and the heat developed during this change rendering the carbon incandescent; and the last, or outer zone, one in which the carbon is converted into carbonic anhydride. As no solid is present in this zone, it is non-luminous. This explanation has a great advantage—it is simple; unfortunately, it is also grossly inaccurate. The Bunsen jet is explained as being similar to the ordinary jet, except that the luminous zone is wanting.

Professor Smithells, of Leeds, who has done good work on this subject, has at the same time shown that these explanations are wrong, and that they are not even warranted when considered alongside of Sir Humphry Davy's original statement. Smithells started his experiments by watching the gradual development of a flame obtained from a very small amount of combustible. The small flame thus obtained is practically non-luminous, and consists of a hollow, bright blue cone surrounded by a lilac colored border. When more gas is turned on, a luminous spot is formed, which, as the quantity of gas is increased, becomes more and more developed. The original inner cone now forms a small fraction of the whole flame, and constitutes the blue region.

If, instead of starting with a non-luminous flame, we commence with a luminous jet, and gradually admit air, the same series of changes are noticed; but, of course, in the reverse order. From these experiments, Smithells concludes that there is no essential difference between an ordinary luminous and the non-luminous flame—that the non-luminous flame may be considered as a gas air flame with the blue and non-luminous regions at a maximum, and the yellow luminous regions at a minimum; while the luminous flame is to be regarded as a gas air flame with the blue and non-luminous parts at a minimum, and the yellow luminous region at a maximum.

When air in excess is passed into the Bunsen flame, it "strikes back." Smithells has devised an instrument to show this process, and to demonstrate what actually happens. When the tube of the Bunsen is lengthened by means of a glass tube, and the excess of air is gradually admitted, it is noticed that the process of "striking back" takes place in two stages. First, the inner cone passes down the tube; then the outer portion. When working with a plain tube, it is difficult to regulate the process so as to arrange that the two cones will be retained in the tube for a lengthened period. By introducing a glass rod into the center of the glass tube, however, the upward current of gas is retarded, with the result that, when air is admitted in excess, the inner cone is stopped at the apex of the rod.

A still better method consists in making a constriction in the tube, or by the use of two tubes one inside the other. By the last method, especially, the flame can most readily be split into two, and the products of combustion of the two parts can be separately obtained for analysis. By these means Smithells has shown that the blue region is one of incomplete combustion, in which carbon monoxide, carbonic anhydride, hydrogen and water are the chief substances produced; while in the outer part the hydrogen and carbon monoxide are burned to carbonic anhydride and water. His experiments, therefore, show that carbon is first oxidized and the hydrogen set free, to be afterward consumed in the outer envelope. This is, therefore, directly opposite to what was held in the older theory.

Lewes, who, as you know, has done much work on this subject, holds that the hydrogen diffuses to the outer part, and is there burned. The methane also diffuses, though more slowly, and is consumed in the outer part. The combustion of these bodies raises the temperature of the flame to 500° C., and gradually upwards to 1,000° C. At this temperature, the olefines are converted into acetylene and hydrogen. If the temperature does not rise above 1,000° C., the acetylene polymerizes into benzol; but should the heat rise to 1,200° C., it is split up into carbon and hydrogen. The combustion of the hydrogen then raises the carbon to a state of incandescence, and produces the light. The difficulty of accepting this theory lies in the fact that neither Lewes nor Smithells, nor any other worker so far as I know, has been able to demonstrate the presence of more than a trace of acetylene in the products of the inner zone. Acetylene is a colorless gas with a decidedly garlic odor, and burns with a very smoky and highly luminous flame. It is produced in large quantities when carbide of calcium is placed in water. The carbide is formed when chalk or lime, mixed with carbon, is fused in an electric furnace. There is no difficulty in producing the substance, and if a demand for the body sprang up, doubtless it could be readily produced at a moderate cost. The plant to manufacture acetylene from the carbide need not be costly, and the process is simplicity itself. Unfortunately, however, the gas is practically useless as an enricher; and this fact alone is sufficient to condemn the process for large works. For smaller services, as in country houses, or for railway purposes, it may yet be found useful.

Various attempts have, from time, been made to introduce into the outer zone of the ordinary flame solid bodies which might be raised to a state of incandescence, and so utilize this non-luminous area. Scholl's platinum plate was a step in this direction. None of the patents have, however, been successful so far. In 1868, Hogg, of Edinburgh, took out provisional protection for a process to render platinum cones incandescent. He, however, did not carry out his patent, and it was reserved to the Welsbach Company to bring the idea to a successful issue. They work with a burner which is essentially a Bunsen burner, into which a slight excess of air is drawn. The openings by which the gas passes into the tube are very small, and the amount of gas is therefore comparatively small. The gas is burned to complete combustion, and the heat so obtained is used to raise to incandescence a cone made of various oxides of metals and other bodies.

The apparatus is made in three different sizes—known as the "S," "C" and "D" burners. I have tested the two first of these sizes, and the results show that in the case of ordinary burners the best results for the gas burned are yielded by the larger sizes. Working with a gas which, when tested with ordinary burners, was equal to 25-candle power for each 5 cubic feet consumed, or to 5 candles per cubic foot, I obtained from the "S" burners a light equal to 10.66 candles per cubic foot, or 53.30 candles per 5 cubic feet. The "C" burner gave 21.25-candle power per cubic foot, equal to 106.25 candles per 5 cubic feet. The consumption of gas with the "S" burner was 3 cubic feet, and with the "C" burner, 3.2 cubic feet.

Tested with high-class oil gas, there was a heavy deposit of carbon on the mantle, which quickly destroyed its efficiency. By reducing the quantity of gas passing through the burner, and increasing the quantity of air, the Company have produced a fairly good oil gas consumer. With 1.8 cubic feet of an oil gas which, when tested in the ordinary way, was of 56.60-candle power per 5 cubic feet, I obtained a light

equal to 83.30-candle power per 5 cubic feet. For oil gas, however, the Company will yet require to modify their burners.

That a still greater result can be obtained from the gas, is shown by a modification of the Welsbach burner made by Mr. W. Penman, C.E., of Edinburgh. Mr. Penman's burner was constructed for photographic lantern work, and its peculiarity lies in the introduction of a very slight proportion of oxygen into the flame itself. By this simple addition, a gas of 5-candle power per cubic foot, which, with the ordinary Welsbach "C" burner, gave 12.39-candle power, was raised by Penman's burner to 18.81-candle power; or, in other words, for every candle power given by the ordinary burner, the Welsbach gave 2.47 candles, and the Penman 3.76 candles. This burner burns oil gas splendidly. Working with oil gas of 12-candle power per cubic foot, and which without oxygen gave 16.25-candle power, I got 67.64-candle power, or equal to 338.20-candle power per 5 cubic feet. This is, therefore, very much higher than even the extraordinary results obtained with acetylene.

Penman's burner having been manufactured purely for photographic lantern work, the oxygen was only introduced in front, and a platinum plate is placed behind. Lately I have been working with a burner built on the same principle, but with an oxygen feed all round. My results are satisfactory; but, as they are not yet completed, I do not desire to quote them.

In the preceding remarks I have endeavored to place before you as simply as possible the results of the latest researches. They show that gas need not yet "throw up the sponge" in favor of electricity or any other illuminant. How far we may yet compel gas to yield us still greater illuminating value, must rest with the future. Even "second sight" cannot soar to the heights of possibility.

Means of Preventing Electrolysis of Buried Metal Pipes.

[By Mr. Isaiah H. Farnham, in *Cassier's Magazine*.]

Last year there was read before the American Institute of Electrical Engineers, in New York and Chicago, a paper entitled "Destructive Effect of Electrical Currents on Subterranean Metal Pipes." So numerous and recent had been the examples of pipes destroyed by some "mysterious agent," sometimes attributed to the true cause, but more frequently to some new and unexplainable action, that the scientific public was quite ready for the facts and suggestions set forth in the paper, and, as a natural consequence, the latter was given a wide circulation in scientific and semi-scientific publications.

In order to make clear the connection between that paper and this, the conclusions reached in the former should be repeated here. They were:

1. All single trolley railways, employing the rails as a portion of the circuit, cause electrolytic action and consequent corrosion of pipes in their immediate vicinity, unless special provision is made to prevent it.
2. A fraction of a volt difference of potential between pipes and the damp earth surrounding them, is sufficient to induce the action.
3. Bonding of rails, or providing a metallic return conductor, equal in sectional area and conductivity to the outgoing wires, is insufficient to wholly prevent damage to pipes.
4. Insulating pipes sufficiently to prevent the trouble is impracticable.
5. Breaking the metallic continuity of pipes at sufficiently frequent intervals is impracticable.
6. It is advisable to connect the positive pole of the dynamo to the trolley lines.
7. A large conductor, extending from the grounded side of the dynamo, entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger, will usually insure their protection.
8. It is better to use a separate conductor for each set of pipes to be protected.
9. Connection only at the power station, to water or gas pipes, will not insure their safety.
10. Connection between the pipes and rail, or rail return wires, outside of the danger district, should be carefully avoided.
11. Frequent voltage measurements between the pipes and earth should be obtained, and such changes in return conductors made, as the measurements indicate.

A great deal of discussion upon the general subject has since appeared in print. It is not the writer's object here to occupy space with a lengthy discussion of the facts and views of other writers, but rather to describe a new plan or method for minimizing the danger of electrolysis in cities and towns where single trolley electric railways are operated. Before doing so, however, it seems desirable to point out a few errors which appear to exist in the minds and writings of some, and which may tend to retard the efforts or impair the results of efforts put forth to prevent this new danger to so important a factor in municipalities as the water, gas and electric systems.

The error to which attention is first called is "that careful bonding of the rails will prove a sufficient remedy." The importance of good bonding is great; but no amount of bonding will wholly prevent a portion of the railway current from taking the earth and pipes buried therein, on its return to the station; such current as reaches the pipes, small though it may be, will cause the action, unless means be taken to prevent its leaving the pipes for moist earth. The illustration on this page shows the danger of even small currents. It was reproduced from a photograph of underground telephone cables which were destroyed in Lowell, Mass., in the United States, within a few months, where the electric pressure between the pipe and surrounding earth was found to be less than $\frac{1}{4}$ volt, indicating a comparatively small flow of current.

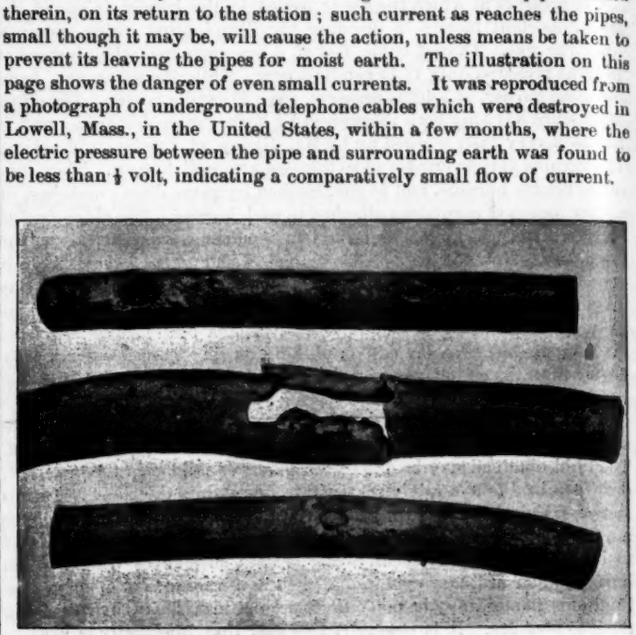


Fig. 1.—What Electrolysis will do with Telephone Cable Coverings.

The second error lies in a proposed plan of joining the pipes to the rails at frequent intervals throughout a town. This has been thought to be a remedy. Such treatment would reduce the action upon the pipes in the district near the power station, but would increase it in other portions of the city. Such a system would prevent any passage of current from pipes to rails through the earth as a medium, but it would cause electric currents to leave the pipes for the earth in localities distant from the power house, returning to them again near the source of power, very much as the current now leaves and returns to the rails in railway systems of usual construction.

The third error is to be found in the assumption "that the danger exists only in large cities, or where the railway construction is unusually bad." Fig. 5 shows the destruction of an iron pipe which occurred in Rockland, a small city of the State of Maine, in the United States, where not more than six cars are ever in operation at one time. It should be remembered, also, that in the city of Boston, where damage to telephone cables has in the past years been considerable, the return conductors are comparatively large and well arranged. Besides the bonding of rails, a very large return wire follows back between the rails, this wire being in some streets $\frac{3}{4}$-inch in diameter; in other streets it is composed of three or five $\frac{3}{8}$-inch copper wires, placed side by side. Add to these conductors other heavy returns placed upon the poles and connecting with the rails at every ten poles or thereabouts, and the sum will indicate what care has been exercised to reinforce the conductivity of the rails. In fact, we are told the return copper in Boston amounts to 70 per cent. that of the outward conductors.

Notwithstanding such a system of rail and copper returns, a current of 500 amperes is taken from the lead sheath of telephone cables in the vicinity of the principal power house in that city—good evidence, certainly, that good construction, as the term is ordinarily used, will not wholly retain the railway current upon the railway system of conductors.

Another error is the suggestion which has been advanced that "it is impossible to tell, with any degree of certainty, whether or not a seriously corroded pipe has been subjected to electrolytic action, or simply to chemical corrosion due to moisture, salts, acids, etc., found in the earth." This notion has, in some instances at least, led the officers of water companies and gas companies to the false conclusion that electric

currents are "fickle," lawless manifestations, especially when encountered in the earth; therefore, it must be useless to search for electrolytic troubles or to attempt any remedy or prevention.

A pipe removed from the spot where it was corroded and presented to the electrician or chemist, with no further facts than its appearance, will, it must be granted, yield no certain or satisfactory proof of the cause which destroyed it; but, fortunately for practical purposes, we may with certainty determine whether or not such a pipe, when in its normal position and under its working conditions, is being electrolyzed or even in danger of such action. The determination is made by taking voltage measurements between the pipe in question and the damp earth immediately surrounding it. Such measurements may be conducted with precision by any intelligent electrician, with the aid of a good voltmeter and two wooden rods, in the lower ends of which are brads connecting with leading wires to the voltmeter. Where the pipes are found to be positive to the earth in which they rest, electric current will certainly flow from the pipes to the earth, and where the flow is in that direction electrolysis is sure to result.

While it is true that the amount of current flowing is the measure of the rapidity of the action, and that the voltmeter measures the pressure rather than the amount of current flowing, it is also a fact that the voltmeter proves to be a better instrument than the ammeter for determining whether or not there is a flow of current and in which direction it passes; and this knowledge it is important to procure in dealing with the question of prevention or remedy. The determination is easily within reach of all, and that, too, before the bursting of the

Fig. 2.—Making Voltage Measurements at a Cable Subway Manhole.

pipes brings the matter to notice too late for remedy. Fig. 2 demonstrates the ease with which potential measurements are made upon electrical cables at manholes in the street.

Having referred to the method of preventing electrolysis which has been employed on a portion of the pipes in Boston and in some other American cities for several years, and to some of the ereoneous ideas on the subject, we may now present the outline for another method of minimizing the danger. No description of this plan has ever before appeared in print. It is furthermore attractive as lying entirely within the power of the railway companies to adopt. It is not excessively expensive, and it does not involve connections with other companies' property, nor the mutual co-operation of cities or corporations. By this method the tracks of the railway will also be preserved from electrolytic action.

In order to bring the principle clearly before the reader, the writer would call attention to a fact generally known but often ignored. In all cities where electric railways operating the single trolley system are in use, and especially where trouble from electrolysis has been discovered, it is found that the earth in one section of the city has a different electrical condition from that in certain other sections. If an insulated wire, having included in its length a suitable galvanometer or voltmeter, is extended between a ground plate located near the railway power house and another ground plate located a mile distant from the first plate, as shown in Fig. 3, a difference of potential will be found to exist between these plates. If the dynamo is connected with its positive pole to the trolley, the ground plate situated at the greater distance will be positive to the plate near the power house.

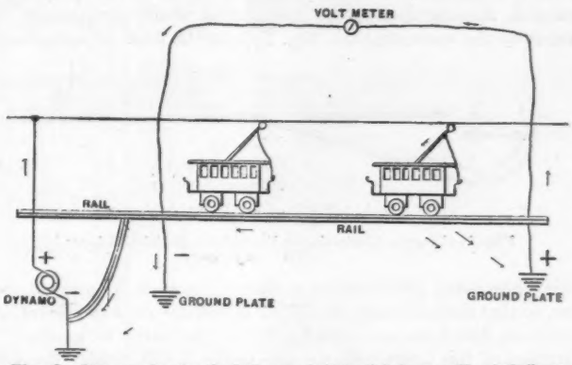


Fig. 3.—Diagram showing the Difference in Potential along an Elecric Railway.

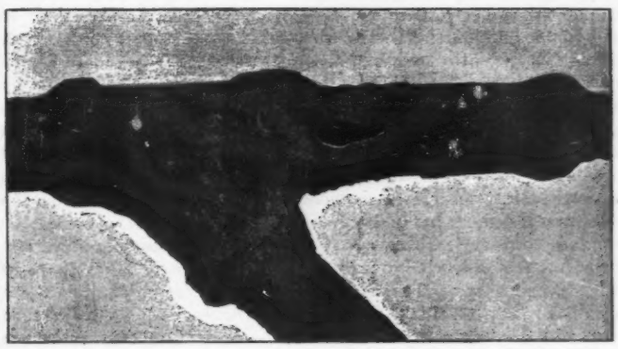


Fig. 4.—An Iron Water Pipe after a Few Weeks' Exposure to Electric Railway Currents.

Some of the fire underwriters recognize this difference of potential as a danger, and they attempt to rule against it. The writer has known such difference of potential to reach 50 volts and more. The earth in the distant territory is, so to speak, saturated with positive electricity, while near the station it is being "pumped out" or made negative by the dynamo. This want of a level, or balance, in the electrical condition of the earth, leads to a flow of the current from the higher to the lower electrical level, much as would occur if water should replace the

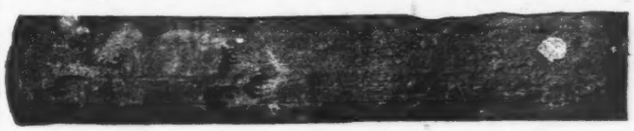


Fig. 5.—Another Example of Electrolysis.

electricity. In flowing, the electricity finds its way into pipes and cables, and, on leaving them at the lower level, causes the electrolytic action.

Fig. 6 will, by analogy, fairly illustrate this want of electrical bal-

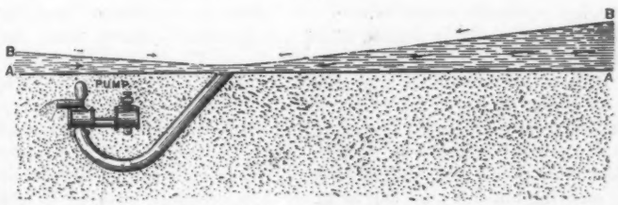


Fig. 6.—Diagram Illustrating the Want of Electrical Balance in the Earth.

ance or level in the earth. The line *A* represents the surface of the earth; *B* the surface of a flood of water produced by a heavy rain, and flowing to a low plane where a pump is drawing the water from the earth in a limited district.

If, now, we can preserve a level or balance in the electrical condition

throughout the city, or, in other words, prevent a difference of potential, there will be no disposition for a current to flow from one portion of the city to another. It is the purpose in the plan now proposed to accomplish this equalization of potential as nearly as possible. To illustarte by the water analogy, Fig. 7 shows the flood of water being

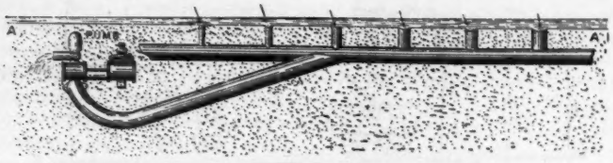


Fig. 7.—Diagram Illustrating an Example of Electrical Balance.

pumped from many points on the surface of the earth by pipes of proper size, so that there is substantially no difference of water level, and therefore no flow from one distant point on the earth to another. A comparison of this figure with the one above it will render the point clearer.

As may be anticipated by a study of the principles already set forth, the new method consists in extending from the negative or rail side of the dynamo an insulated return wire, either on poles or underground, throughout the entire length of the railway, including all cross town or branch tracks. This return wire is to be of such size as to properly carry the current and to maintain the return path at a comparatively low resistance. For a track extending 3 miles in any one direction from the power house a No. 0000 copper wire would give a resistance of but 1 ohm from the most distant point. Two such wires, about ½ inch in diameter each, would not seem excessive in cost, and would render the maximum resistance but ½ ohm from car to power house.

In large railway systems a still heavier main return may be employed. From this general return wire or system of wires frequent connections would be extended to the track system, say one at every other pole (200 feet). Let these connections between the general return wire and the rails be of such size, or shape, as to cause the resistance from the rail at the nearest point to the power house to be the same, no more nor less, than from the most distant rail connection to the power house; that is, with such a system, if the resistance of the circuit from the rail, 3 miles distant, to the power house is ½ ohm, the resistance from any other point along the route of the track shall also be ½ ohm to the power house. Allow no ground connection on the dynamos, and no direct connection to the rails without the proper resistance. Fig. 8

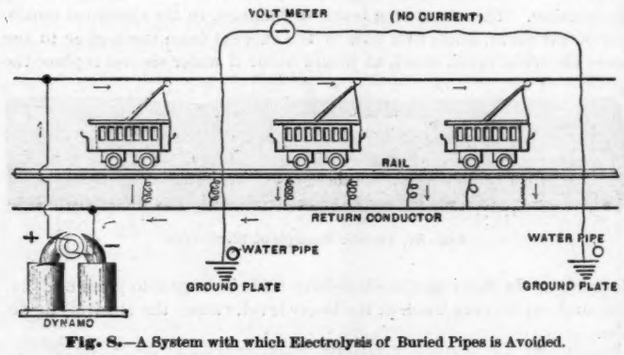


Fig. 8.—A System with which Electrolysis of Buried Pipes is Avoided.

roughly represents such a system. It should be understood that the rails are to be suitably bonded under this, as other systems using the rails for a portion of the electric circuit.

If, now, we imagine an approximately uniform distribution of cars, there can be no rise or fall of potential in the earth except at the very limited areas between the several points where the rails are connected to the general return wire system. Cars are not, of course, equally distributed over a city, and, therefore, perfect results cannot be reached by carrying out this plan, but to adopt it is certainly working in the right direction, and as the distribution of cars approximates uniformity, the advantages of the system will approach the maximum. On the other hand, with the present usual manner of connecting the return wires to the tracks there never can be a condition where a difference of potential will not exist between different sections of a city, no matter how nearly perfect the rail system is constructed as a return conductor, and, therefore, there can be no elimination of current passing from a higher to a lower potential throughout a city; and, of course, as the currents pass through the earth, pipes are brought into the path, and constitute a portion of the electric conductor with all the possibilities of electrolysis wherever, from a poor joint or for other reasons, the currents leave the pipes for the damp earth on their way to the negative side of the dynamo.

This system of returning the railway current will accomplish several desirable ends. 1. It will allow but very little current to enter the earth and flow therein. 2. The current through the earth being minimized, electrolysis will to that extent be prevented. 3. Having by this means reduced the danger of electrolysis to small proportions, it will be comparatively easy to take care of the remaining danger, if such be found, by resorting to the means described in the previous paper. 4. In addition to practically overcoming the dangers of electrolysis, the annoyance to telegraph, telephone, burglar alarm and other grounded circuits, due to difference of potential in different sections of a city, will be incidentally removed.

The equi-potential return system just described has so far been tried in a New England city as to indicate practically that the benefits claimed for it may be confidently expected. There are no patents which will interfere, as the writer understands it, with the use of either system here referred to or described, for preventing electrolysis of underground pipes and other metal bodies. Railways, cities and corporations are at liberty to avail themselves of the results of many experiments, tests and practical experience briefly referred to here.

Mr. Frederick Siemens on Illuminating Gas for Heating Purposes.

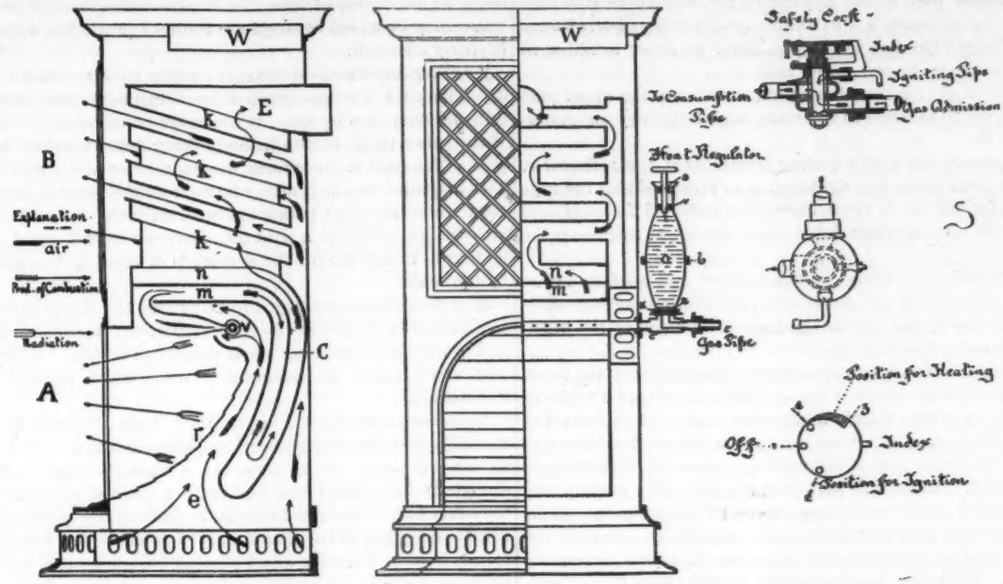
[Translated by Mr. F. B. Badt for *Engineering Magazine*.]

There is hardly any more important and more difficult question to be solved than the rational heating of dwellings. This is evident from the fact that, though many systems and constructions have been applied, not one exists which meets all the requirements.

A heating appliance must be cheap, not only as to first installation, but especially as to operating expense; it must be easy to attend to, and must not require any intelligent attendance, and, above all, it must be agreeable and not detrimental to the health. Furthermore, it must be easily regulated, preferably by an automatic device, and must not cause any nuisance outside; for instance, it must not evolve any smoke—that being very often the cause of complaints in otherwise good heating installations.

How are these requirements met in practice? The first installation is too expensive in most of the central heating systems, which show lesser or greater deficiencies according to the system employed. The hot air heating system has a very disagreeable effect on the organs of respiration, for the reason that the air is hot and dry; from a hygienic standpoint, therefore, it is to be condemned, because the air which we breathe should be cool and nearly saturated with moisture. On the other hand, the existing systems are too expensive in operation, as, for instance, the English grate, which probably best meets the hygienic requirements in a dwelling, but which vitiates the air of the neighborhood—at least in large cities—with the escaping smoke and other products of combustion. The English grate heating system is very expensive on account of the large waste of fuel, and because it makes necessary a continuous care of the grate; in other respects it is agreeable and comfortable, mainly because only *radiating heat* is employed, similar to the heat from the sun, which is certainly the most agreeable and hygienic heat. Heating by large porcelain tile stoves is cheap, but from a hygienic point of view it is bad, as almost no radiating heat is obtained. The convection of heat by means of these large, moderately-heated porcelain stoves is effected in the main by the circulation of the air, as the air in the room rises against the heated surfaces of the stove and falls against the cooler walls of the room.

The advantage of the porcelain stoves consists of the moderate degree to which the surfaces of the stove are heated, but from a hygienic point of view this mode of heating must be condemned, because the effect is about the same as that of the hot air system. The circulation of the air, as described, heats the air of the room, which in the English grate system the radiating heat leaves the air of the room cool, but, on the other hand, heats the walls and all the objects in the room in exactly the same manner as the sun heats everything in nature. Another very uncomfortable, but simple, method of heating is by means of the so-called "Cannon" stoves. These stoves are usually made of iron; they get very hot on the outside, and therefore radiate much heat; they act less by heating the air than by radiation, but they vitiate the air in the room in other respects to a very high degree. The heated iron



permits the poisonous gas of combustion (for instance, carbonic acid gas) to pass through it; besides the air in the room rises against the hot surfaces of the iron stove as in the case of the porcelain stoves; only the air gets heated to such a degree that it burns and carbonizes many particles of dust composed of organic substances always prevalent in air. This causes a highly disagreeable odor, which will always be found where stove surfaces heated to a high degree are exposed to the air of the room.

I classify under the heading "Cannon" or "Iron Stoves" all stoves whose external surface is heated to more than 212° F. These iron stoves exist in innumerable types, and are made under many systems, but are usually employed only as makeshifts, it being unbearable to any human being to breathe for any length of time the half burned and singed organic matter contained in the air.

It can be easily seen that the temperature of the surface of a stove should be kept below 212° F. This is the reason that in all countries with cold and long winters, where the necessity for heating apparatus is the greatest, the large, moderately-heated porcelain stoves are generally used; while in countries with moderate winters the iron stoves prevail, because heating apparatus is used rather exceptionally. In all central heating systems the low pressure steam heat is preferred, although the first cost and the operating expenses are comparatively high on account of the large heating surfaces needed. The air under system is more agreeable and healthful than in cheaper installations, which operate with smaller heating surfaces and higher tempera tures.

I might go into still more detail in these comparisons, but I assume that I shall be readily understood when I say that, for heating dwellings, the ideal apparatus is one which generates a large amount of radiating heat, but exposes only very moderately heated surfaces. This leads me to the consideration of the regenerative gas stove, which was constructed to meet these ideal conditions. As a common gas flame does not radiate over 30 per cent. of its heat, I increase this percentage by using an intensely white regenerative gas flame, similar to that used for lighting purposes. Such a flame radiates, on account of its much higher temperature, at least twice as much heat as does the common gas flame; however, the escaping products of combustion of the very hot flame convey less heat to the stove, because the regenerator absorbs most of the heat of combustion for the purpose of heating the necessary amount of air previous to combustion.

In order to make myself clear on the subject, I want to state that I commenced about twelve years ago to manufacture heating stoves for illuminating gas and with regeneration of heat, which were also called accumulators. In 1885 I obtained my German and other patents, and I then commenced to offer such stoves to the public. The result was that a good many competitors appeared, offering stoves to be used with illuminating gas, partly with and partly without radiating heat, but all without a heat accumulator. In the beginning these gas heating stoves did not find favor, partly on account of the erroneous supposition that the use of illuminating gas would be too costly, and then because the intensely illuminating regenerative gas flame had a blinding effect on the eye. When, finally, a few years ago, during the Brussels Exposition, such a stove, without a regenerator or accumulator, made its appearance, in which the heating radiating gas flame was invisible, but gave its effect indirectly by means of a copper reflector, it found more favor with the public. Since the appearance of the indirectly operating reflector, which I employ also, the demand for regenerative gas stoves has increased considerably, in spite of the many competitors who do not employ regenerative apparatus, but succeeded nevertheless in selling a good many stoves on account of their cheapness and because they called them "regenerative" or "double regenerative." I would not care about this competition if the public were not deceived by cheap stoves, falsely called regenerative, thereby injuring the reputation of the system.

As it would take too much space to relate the whole business development of my heating system, I confine myself to its description as it stands to-day.

The drawing (Figs. 1 and 2) shows, in two cross sections, that the heating apparatus consists of two main parts—viz., the simple radiating grate arrangement *A*, and the stove *B*, which is built over the grate for the complete utilization of the remaining heat. The gas heating flame is formed by leading illuminating gas through the horizontal pipe *v*, which is located above the reflector *r*; the pipe contains in the forward direction one or more fine holes through which the gas can escape in horizontal flames.

The air necessary for combustion flows in the beginning, when the apparatus is cold, out of the space in front of the reflector to the burners. The flames are pointed horizontally and forward (compare drawing) and radiate a great deal of their heat on the reflector *r*; then they are led through the downward channel *m* of the regenerator *C*, and then again forward through the channel *n* in the upper part of the stove *B*, and finally escape through the stove pipe *E*. In leading the products of combustion downward the regenerative apparatus is heated as contemplated. The necessary air of combustion, which is of course cold, enters now through the vertical regenerator channel *e* from below; the air then moves in a direction opposite to that of the products of combustion, which are moving downward in shaft *n*, and in this manner the air absorbs the greater part of the heat of the products of combustion; then, highly heated, the air mixes from above and below with the gas escaping out of pipe *v*. The air channel *e*, on account of its heating by the product of combustion and on account of its almost vertical position, becomes a small chimney, and conducts the hot air to the gas flames automatically—*i.e.*, independently of the main chimney *E*. This automatic conveyance of the hot air is a highly important requirement, because the whole heating apparatus becomes independent of the unreliable draught of the chimney, and may be employed even where there is no chimney at all. In the latter case, however, the products of combustion would escape into the room, which must be obviated for hygienic reasons. The products of combustion, already considerably cooled in the regenerator *C*, now heat, in the moderate man-

ner desired, the upper part of the apparatus, the real stove *B*, which consists of a number of boxes (*k k k*) so arranged that they leave spaces and constitute a large extended heating surface, in order to utilize in the best possible manner the remaining heat.

Provision is also made for the evaporation of water in the upper part of the stove, in order to saturate to a certain extent the dry air generated by the stove *B*.

An important part of the whole heating apparatus is the reflector *r*, which, as can be seen from the drawing, is so arranged that the rays of light and heat falling on it from above are reflected forward and sidewise, while the intense white flame itself cannot be seen from the room.

By means of the reflector, whose material, color and surface are so selected that the rays of heat are thown completely into the room without disturbing the eye by the rays of light or the images of the burners, the room is mainly heated in the lower part, so that at the height of, say, five feet the temperature is considerably lower than at the floor. By such an arragement the comfort is greatly increased and a waste of heat is prevented—a waste which must exist when, as in the other heating systems, the ceiling of a room is heated while the floor remains cold. I describe the upper part of the heating apparatus, the real stove *B*, only superficially, because this part does not show any novelty and might even be omitted under certain conditions. Where considerations of the greatest economy do not exist, it might be well to use only the lower part of the heating appartus, the real grate *A*, with its excessive radiation of heat. With the small surfaces of the stove *B*, and with its low degree of heat, the effects of the stove must be the same, though in a small degree, as in the large porcelain stove already described. As by means of the regenerative system a much greater part of the heat generated by combustion is converted into radiating heat and led to the room in the most advantageous manner, it is the more advisable to do away with the stove *B*. Lately this arrangement has met with much favor, especially in the more luxurious dwellings.

Another highly important advantage, which is made possible only by the application of illuminating gas for the generation of heat, consists in the possibility of the application of an automatic regulator. This heat regulator, which may be adjusted for any desired temperature, raises or lowers the temperature by permitting more or less gas to flow to the burners. This arrangement not only adds to the comfort, but prevents the waste of gas. It is fair to assume that the consumption of fuel in all other heating systems is increased by the lack of an automatic heat regulator, because the heating is effected without regard to the existing temperature. The consumption of fuel, of course, could be diminished if an economical mode of heating were adopted, but this is not alone sufficient; it is necessary also to adjust the heating in accordance with the continually changing demand for heat. As the automatic heat regulator permits the use of fuel in exact proportion to the momentary demand, and as the generated heat is directed by means of the reflector to the place where it is needed, the gas heating stove shows an actual saving in fuel in comparison with all other systems, in spite of the comparatively high price of illuminating gas.

The heat regulator constructed by me is illustrated in Fig. 2. It consists of an oval metal vessel *a*, to which is attached below a telescoping arrangement *z*, made out of thin tin. To the lower end of the telescoping arrangement is attached a small cone *k*, which serves to regulate the flow of gas through the pipes *c* and *c*^{1}, *c* being inside of *c*^{1}. Pipe *c* is connected with the gas service pipe, and *c*^{1} with the stove. The flow of the gas is indicated by the arrows. The vessel *a* is provided in its upper end with a small pipe *r*, which terminates in a little funnel *t*; the latter contains a little needle valve *v*, which may be opened or closed by means of thumb screw *s*.

The whole apparatus is filled with water in such a manner that the water becomes visible in the funnel and does away with air bubbles. Hoop *b* may be compressed by means of a screw, thus compressing vessel *a* more or less, so that the water in the funnel will visibly rise or fall.

Just as soon as the whole apparatus is regulated so that cone *k* at a certain temperature, say 54° F., with the needle valve *v* closed, permits a sufficient amount of gas to pass, the water in vessel *a* will expand with any rise of temperature; this will cause the telescoping arrangement to move cone *k* in a downward direction, and consequently the flow of gas will be partially or entirely shut off. If the water in the vessel *a* cools, the telescoping arrangement will contract, and the cone *k* will again permit the passage of the gas in proportion to the degree of temperature.

The advantage of such a temperature regulator over other well known devices lies in the fact that, in case of escape of the liquid, which will occur in the course of time, the needle valve *v* may be opened, and water may be added through the funnel *t*, until the apparatus is again properiy adjusted.

Another important device is the safety cock *s* with self igniter. (Fig. 3). This cock is so constructed that it can be turned only in one direction and only step by step. If the index points to step 1, the cock closes. If the index turns to step 2, the igniting flame touches the gas service pipe. The next step connects the gas service pipe with the main flame. This is ignited on the igniting flame, and the latter is again shut off, so that, when the index points to step 3, only the main flame is burning and the ignited flame is shut off. Between steps 3 and 4, the hand may be moved to and fro for the admission of more or less gas, as indicated by the scale.

If it becomes necessary to extinguish the flame, the index is set to 1. Such a safety device is very important, because without it negligence and ignorance may cause many bad results. Even malicious intent could cause an irregularity only when assisted by technical knowledge.

In closing this paper, I beg to draw your attention to the fact that probably illuminating gas will be superseded to a very large extent by the electric light. It is, however, a rather curious coincidence that electricity for heating can find only a limited application, while, on the other hand, illuminating gas is particularly adapted for it. The illuminating gas as fuel is not only applicable for heating stoves, but for all feasible domestic and technical purposes; it is well adapted for cooking, melting, annealing and other operations. It has become more and more evident that illuminating gas is particularly adapted for heating purposes on account of its great radiation of heat, radiating heat being the best for heating purposes. Where heating by contact is required, we may apply the Bunsen or similar burners, so that even for these purposes the illuminating gas can be used to advantage. I beg to remind you of the Auer incandescent light, and various cooking and heating apparatuses.

In most of the heating and melting operations, especially in all cases where the regenerative system can be used with advantage, it is the radiating heat that we want, as I pointed out some years ago in my many papers read in Germany and England. I refer to these papers and the many successes which I have achieved with my regenerative gas stoves in many technical industries, especially in the glass and steel industries.

I think I may predict that the present illuminating gas will gradually change its role, and will be used in future mainly as fuel. Especially in large cities would this change be advantageous; but in order to abtain this result the illuminating gas, or, rather, the heating gas, must be considerably reduced in cost. Prospects for such reduction are good, because gas prices have been continually on the decline, and larger competition and the great progress made in the methods of manufacturing gas will contribute their share, especially if the gas is used to a larger extent for heating purposes.

The Measurement of Jacket Water in a Gas Engine.

By Mr. Frederick Grover, A.M.I.C.E.

The quantity of jacket water required for cooling the cylinder of a gas engine depends upon two conditions. Firstly, it must vary as the heat developed in the explosion cylinder, or, other things being equal, as the horse power of the engine; and, secondly, it is controlled by a desirable limit of temperature of the cylinder walls and piston. By reference to the trials of engines manufactured by leading firms, it will be seen that the quantity of heat thrown away in the jacket water amounts to from 27 per cent. to about 45 per cent. of the total heat developed by the explosion. This reduction from 45 per cent. to 27 per cent. is not necessarily due to a decrease in the quantity of water passed through the jacket, but, in some cases, to an increase of piston speed. On the other hand, if the piston speed of two engines be the same, then, other things being equal, that engine will be the most economical with the least quantity of jacket water supplied to it, provided, of course, that there are no difficulties in keeping it well lubricated.

For our present purpose we shall assume that 36 per cent. of our total heat is lost in the jacket. Upon this basis we can at once calculate the required quantity of water. An average consumption of gas per indicated horse power per hour is 22 cubic feet; and the heat value of a cubic foot of coal gas may be taken at 620 units. Thus, per hour, we shall generate $620 \times 22 = 13{,}640$ thermal units, 36 per cent. of which will be carried away in the jacket water; $\frac{13{,}640 \times 36}{100} = 4{,}910 =$ heat

given to jackets per indicated horse power per hour. For continuous running with circulating tanks it is not advisable to increase the temperature beyond 140° F., unless the tanks are exceptionally large. Usually the circulating tanks contain from 20 to 30 gallons of water per indicated horse power. We may allow the discharge from the jacket to go up to 190° F., and we may take the normal atmospheric temperature for the jacket feed. We then get the rise of temperature of the jacket water to be 190 — 60 = 130°. A British thermal unit being a measure of heat required to raise 1 lb. of water 1° F., we obtain $\frac{4,910}{130} = 37.8$ lb. of water per indicated horse power per hour to keep the cylinder cool. This is equal to 3.78, or, say, 3.8 gallons per indicated horse power per hour. The water may be delivered to the jacket direct from the mains and regulated by a suitable valve. For testing purposes this is perhaps the most convenient arrangement, as it enables the discharge measuring tank to be placed in almost any position with regard to the cylinder, and the quantity can be regulated to a nicety. As by this arrangement the jacket discharge must run to waste, it is far more usual to arrange a set of tanks through which the water may circulate and cool itself by radiation.

In places where water may be run through the jacket by gravity, it is desirable that the circulation tanks be dispensed with, provided, of course, that the supply of fresh water is not an expensive item. By such an arrangement the quantity of jacket supply may be made constant, but by the circulating system the jacket supply is greatest when the engine is first started, and decreases as the water in the tanks becomes hotter. Thus the conditions of greatest economy cannot be obtained for the whole period of working.

If we examine a general arrangement of circulating tanks, we shall see how this occurs. Call two cylindrical tanks, about 8 feet high, A and B. A is connected to the jacket by a pipe from the bottom of the tank, entering the lowest part of the jacket. A pipe from the top of the jacket affords a passage for the water into B. It is, of course, important that this pipe is not made higher than the normal level of the water in the tanks. B is connected to A by a pipe starting from the bottom of B, and taken out into A at the normal level. The tanks are filled up, any excess passing away through the drain. This drain should always be put on the discharge tank B, and the cold feed let into the first tank A. By this means the hottest water is drained off.

When the engine is started the jacket temperature reaches perhaps 160° F. The water in the jacket expands and rises. Now, the increase in volume of water raised from 39° to 212° is 0.0477, or about $\frac{1}{21}$th, and, therefore, from 60° to 160° we may take the increase to be about 0.0378, or about $\frac{1}{27}$th of the volume. A column of water 8 feet high will then become 8 + 8 × 0.0378 = 8.3 feet, or nearly 8 feet 3½ inches. Thus there is an equivalent head of water in A of 3½ inches, which gives a velocity (neglecting friction, which may be considerable) of 4.4 feet per second, or 263 feet per minute. The hot discharge into B raises its level and causes A to fill from the lower part of B. Thus a brisk circulation is kept up until the water in A gets hot; then the equivalent heat is reduced, and consequently the circulation settles down to a normal flow. This may be stimulated to any extent by admitting cold water into A to pass through the jacket and drain off from B.

With the arrangement described above the quantity of jacket water may be measured by emptying the tank B and using it as a measuring tank. The total quantity of water passed through the jacket must then be fed into A, and if this supply stops the circulation will stop. A scale in the tank B will suffice to ascertain the quantity used during the trial.

The Clay Industry of the United States.

The statistics of the clay working industries of the United States are reviewed in the forthcoming report of the Geological Survey, and it is the first time that this subject has been treated in an annual survey report. A list of over 14,000 operators was secured, and information obtained from nearly all of them.

The total value of the clay products of the United States in 1894, excluding pottery, was $65,389,748. The only figures with which comparison can be made are the census of 1880, when the value of the same classes of products was placed at $67,770,695. This decline of $2,380,913 is due, no doubt, to the general financial depression. The great strikes of the year also had the effect of lessening the product to an appreciable degree, the great clay producing region, the Mississippi and Ohio Valleys, being the center of these strikes.

As would be supposed, the product of greatest value is building brick, this alone making over 53 per cent. of the total, the number aggregating 6,152,420,000 brick. To give a more striking idea of the number of common and pressed brick made last year, of which there is a record, they would make a walk over 10 feet wide around the globe, or cover an area of 49 square miles, assuming the average sized brick to be 8 by 4 inches. If to this were added the 457,371,000 paving brick made this year, the walk would be over 11 feet in width.

Ohio leads the list of States in clay manufacture, its product being valued at $10,668,000, while of the forty-nine States and Territories which contributed to the total Wyoming is the lowest in the scale, its product being valued at $6,850. The States embracing the great clay producing region between the Ohio and Mississippi Rivers, together with Pennsylvania, New York and New Jersey, produced over two-thirds of the entire product, 67.05 per cent., while Ohio, Indiana, Illinois and Iowa produced nearly 28 per cent.

The total amount of clay, china or kaolin, wrought and underwrought, imported during 1894 was 83,157 long tons, valued at $653,949.

The total value of brown earthenware and common stoneware imported and entered for consumption in the United States during 1894 was $47,114; of china and porcelain not decorated the value was $1,550,950; china and porcelain decorated, $5,392,648; other earthen, stone or crockery-glazed, etc., was $176,391.

In this review Mr. Heinrich Ries states that, in spite of the financial depression, the past year has been one of importance and progress to the clay working industry. The establishment of a school for the training of clay workers, in connection with the Ohio State University, is a step toward giving proper and deserving recognition to the clay working industries of this country. Such schools are by no means new abroad, and have done much toward the progress and development of the ceramic art in their respective countries.

Engineers have heretofore held, and do still to some extent, continues Mr. Ries, that a paving brick whose crushing resistance is less than 10,000 pounds per square inch should be rejected, and some have even set the limit at 12,000 pounds. It was furthermore thought by many that this was the most important test to which the brick could be subjected; opinion is, however, changing, for it is beginning to be understood that in actual usage the brick is seldom, if ever, subjected to such pressure. For paving brick the absorption and abrasion tests are more important. On the other hand, too much leniency exists with regard to common building brick. Strength is an important item in their construction, and should be carefully looked after.

The recent experiments of Mr. E. S. Ficks bring out very clearly the great variation which exists in the size of brick and the small dimensions of some of them. There is a tendency on the part of the manufacturer to decrease the size of his brick in order to gain more profit and keep the existing ones from becoming smaller. This total lack of uniformity is a matter which should be regulated by legislation.

The general practice among American brick manufacturers is to use the ordinary stone kiln for burning common brick, and down-draught kiln for better and more refractory ware. Continuous kilns are a comparatively recent introduction in the American clay working industry. Nearly all of those used in this country are modifications of the Hoffman kiln, which has been successfully used abroad for some years. They consist essentially of an endless tunnel, divided into compartments by easily removable partitions. The heat from the burning bricks in one compartment is used to dry out those in another chamber not yet burned. The continuous kiln so far has not proved a success in this country. The cost of erection is high, the kiln requires considerable skill to operate, and is hard to control. It has been tried for burning paving brick, but its action is too quick to permit annealing of the ware. It has not shown itself adapted to ornamental brick on account of the great difficulty to control the color. Its chief use is for burning refractory ware, which needs much fuel and where color is unimportant. The kilns require little labor but need a good quality of fuel.

Mr. H. A. Wheeler states that continuous kilns are used at St. Louis and Fulton, Mo., for burning fire brick. At Galesburg, Ills., attempts have been made to burn paving brick in continuous kilns, but they were unsuccessful. They are somewhat used in Ohio and at one locality in California for burning brick.

It is well known that iron, lime, magnesia and the alkalies lower the fusibility of clay often to a great extent. The fact was expressed by Bischoff in the following equations:

$$\text{Fusibility—quotient, } \frac{\text{Alumina}}{\text{Silica.}} \quad \frac{\text{Alumina}}{\text{Fluxes.}}$$

According to the above, the more refractory a clay the more alumina it must contain.

Recent experiments by Wheeler on Missouri clays show that the alumina may be replaced by sand without affecting the fusibility of the clay, whereas detrimental impurities, especially alkalies, greatly increase the fusibility, and furthermore, the fineness of grain has an important influence on its refractoriness. Therefore Bischoff's formula is unreliable.

Another series of experiments has been made by H. O. Hoffman and C. D. Demond to determine the refractory values of clay by indirect methods. The method consisted in mixing fire clays with varying proportions of calcium carbonate and silica to render them fusible at temperatures below the melting point of platinum. Common brick clays were mixed with alumina and silica to decrease their fusibility. The object was to obtain a standard temperature at which both fire clays and common brick clays could be tested; the amount of ingredients required by each clay for fusion was the measure of its refractoriness.

The use of brick dust mortar as a substitute for hydraulic cement when the latter cannot be obtained is now often recommended. The mixtures of brick dust and quicklime showed that blocks one-half inch thick, after immersion in water four months, bore without crumbling or splitting a pressure of 1,500 pounds per square inch. The addition of 10 per cent. brick dust to common mortar is said to prevent disintegration.

The paving brick industry and market are confined largely to the cities of the Central States, Philadelphia being the only large Eastern city which has adopted brick pavements to any extent. One reason for this may be that the cost of transportation prevents competition with asphalt. Over one-half the cities now using brick for paving are in Ohio, Indiana, Illinois and Iowa, those States being the center of manufacture.

Vitrification begins at a red heat in most clays, and it is often found that a mixture of two clays, one possessing refractoriness and the other fusibility, give the best results. Mr. Mead claims that in order to vitrify a clay should contain at least 3 per cent. potash, 3½ per cent. soda, or 5 per cent. lime or magnesia, or 8 per cent. iron, or a combined proportion of any or all of these fluxes equal to these amounts.

The heat required to vitrify a clay varies, and some of the fire clays used cannot be said to vitrify. In Ohio it was found that the heat required to vitrify clay or shale was about 1,860° F. The fusibility seemed to be due partly to the alkaline earths and alkalies present. The iron did not seem to aid much in the fusion, as vitrification began while the iron was still in the form of sequioxide, and a subsequent elevation of temperature breaks it up, as is shown in the darker color of the brick.

Three tests are usually applied to vitrified bricks—absorption, abrasion and crushing. A thoroughly vitrified brick must of necessity be dense, and absorption will therefore be a measure of the porosity. The absorption is determined by weighing the thoroughly dry sample, immersing in clean water from 48 to 72 hours, then wiping dry and weighing again. Vitrified bricks should not show a gain in weight of over 2 per cent. Bricks made from the fire clays which will not vitrify so easily will naturally show higher absorption. This absorption test is of great importance in our severe nothern climate.

The test of abrasion approximates closely the conditions under which the brick is used, and is therefore an important one. The usual method employed is to put the bricks in an ordinary foundry rather, filling it about one-third full. It is then set in motion at the rate of 30 revolutions per minute, and about 1,000 turns are sufficient. The bricks are weighed before and after to determine the loss by abrasion.

The amount of pressure a paving brick shall be able to withstand is an unsettled matter. Some engineers refuse to accept a brick which will not stand 12,000 pounds per square inch, but this is undoubtedly too high a limit, for when laid in pavements it is abrasion and not so much pressure to which the bricks are subjected.

From recent tests made in Ohio to determine the relative merits of paving brick made on end-cut machinery, whether auger or plunger, and those made on side-cut machinery, the result obtained was decidedly in favor of side-cut material. The advantages of a brick pavement are smoothness without being slippery, reasonable cost and good sanitary quality. The color of a paving brick is no guide to its quality, except when bricks from the same factory are compared.

Building brick was among the earliest of the clay products of the United States, and at the present day the manufacture of low grade brick is one of great importance. The methods of brick making have made enormous progress in the last twenty years, and manufacturers have exerted all their efforts to perfect the better grades, but the same cannot be said of common brick. Unfortunately the contractor, whose business it is to see that the bricks are up to the standard of good quality, accepts almost anything so long as it is fairly hard.

Common brick can be made from almost any clay, and with proper care a fair product can be obtained. A common brick should have smooth surfaces and parallel sides, and be hard, compact, and uniform in texture. They should not absorb over 10 or 15 per cent. of water when hard burned, and they should bear a crushing resistance of at least 3,000 pounds per square inch.

Pressed brick are made from carefully prepared and thoroughly tempered clay. The Pompeiian brick is a mottled brick which has been much used in New York especially. The largest manufacturers of dry press brick are in Chicago and St. Louis, and indeed throughout the entire West this style of front brick is practically the only one used. Dry press machines were introduced into this country about twenty years ago. The method is rapidly gaining favor, and architects are losing their not wholly warranted aversion to bricks made by this process. Dry press bricks are the densest made, but they consist simply of an agglomeration of particles which owe their conjunction to pressure, and even though these particles may become vitrified in burning they do not always unite.

The value of ornamental terra cotta produced in the United States annually is about $2,000,000. The requisite conditions of clay for making terra cotta are: Even shrinkage in burning and not over one inch per foot; it should burn to a hard product of even colors; it should not contain an excess of soluble salts which would cause it to "whitewash."

Terra cotta lumber, made of a mixture of sawdust and clay, is extensively used for fireproof arches, partition walls, sheathing for roofs, etc. Its weight is one-half that of bricks, and it can be laid much cheaper. Terra cotta lumber, or fireproofing, can be nailed or sawed like wood, and it is a poor conductor of heat and sound.

There are at the present day not over ten roofing tile manufacturers in the United States. Popular opinion does not look with great favor on a tile roof, except for costly and highly decorated buildings. The advantages of a tile roof are beauty, resistance to heat and frost, and durability. The objections are cost, as it is more expensive than wood or iron, and weight, due to the tile itself and the laying of it in cement.

Any clay that will make a good building brick will in most instances make a good drain tile. Drain tiles range in size from 2 to 12 inches in diameter, and 1 to 3 feet in length. The great drain tile producing region is that of the Central States—Illinois, Indiana, Iowa and Ohio. Drain tile sewer pipe and terra cotta lumber are often made in one factory, as all three can be moulded in a sewer pipe press.

The manufacture of glass pots is one of the higher branches of the refractory ware business, as they are required to stand a very high degree of heat, great extremes of temperature, and the corrosion of molten glass. The clay has to be of a very high grade, and most of it comes from Germany and St. Louis, Mo. Ohio and New Jersey furnish a small amount. The pots are built by hand, piece by piece, and take about six weeks to reach completion.

The great centers of the porcelain and china industry are East Liverpool, Ohio, and Trenton, N. J. Some of the dinner and tea sets made at Trenton compare favorably in weight, translucency and finish with the best fabric of Limoges. The pottery industry of Trenton has a yearly output valued at about $4,000,000.

The production of enameled brick in 1893 was about 4½ million, with an average selling price of $90 per 1,000. This brick forms an excellent material for facing walls, both exterior and interior. Being impervious to moisture, it is very suitable for walls of dissecting rooms and hospitals, and many thousands have been used for that purpose.

American and Russian Petroleum.

The *American Manufacturer* notes that Mr. Goulishambarow, the Russian petroleum statistician, who visited the United States in 1893, claims, in a recent article in his home journals, that the American petroleum production has steadily declined during the last 10 years, that the quality of the American product has deteriorated, and from these alleged facts draws the conclusion that in the not distant future Russia, as an oil producer, will have vanquished the United States. Mr. Goulishambarow states that Russia now furnishes 26 per cent. of the world's production of oil, and gives a table showing the crude production of Russia and America in metric tons of 2,205 pounds from 1884 to 1893, which we have changed to tons of 2,240 pounds and reproduce as follows:

Production of Crude Petroleum in the United States and Russia, 1884 to 1893, in Tons 2,240 Pounds.

	United States.	Russia.
1884	3,026,325	1,454,873
1885	2,730,029	1,870,410
1886	3,506,601	2,418,609
1887	3,533,783	2,660,470
1888	3,450,436	3,105,445
1889	4,561,489	3,259,123
1890	5,726,106	3,917,212
1891	6,784,408	4,682,095
1892	6,311,684	4,828,351
1893	6,049,764	5,457,995

We quote Mr. Goulishambarow's statements and figures at second-hand and not from the original Russian, but if he is correctly reported, the actual facts do not bear out his statements.

In the first place, while the last two years of the period 1884 to 1893 do show a reduced production in the United States, the production from 1884 to 1891 increased, according to the report of Mr. Jos. D. Weeks to to the United States Geological Survey (see below), from 24,218,438 barrels in 1884 to 54,291,980 barrels in 1891, an increase of 30,000,000 barrels, or 125 per cent. This does not indicate a steady decline in production as alleged. What the changes in production of crude petroleum in the United States have been in 10 years will be evident from the following table, in which we distinguish between the production of the Appalachian oil field—that is, of New York, Pennsylvania, West Virginia and Eastern Ohio—of the limestone oils of Ohio and Indiana and of the oils of the rest of the country:

Production of Crude Petroleum in the United States, 1884 to 1893, in Barrels 42 Gallons.

	Appalachian Field.	Limestone Oil, Ohio and Indiana.	Other Districts.	Total.
1884	23,953,090	.....	265,348	24,218,438
1885	21,528,621	.....	318,584	21,847,205
1886	26,603,945	1,064,025	596,871	28,064,841
1887	22,873,450	4,650,375	755,041	28,278,866
1888	16,899,701	9,682,683	1,029,641	27,612,025
1889	22,349,825	12,186,564	627,124	35,163,513
1890	30,067,307	15,078,378	676,987	45,822,672
1891	35,839,777	17,452,602	999,601	54,291,980
1892	33,425,877	15,867,575	1,365,684	50,509,136
1893	31,362,890	15,982,097	1,067,679	48,412,666

From this table it will be seen that while 1885 shows a reduced production as compared with 1884, every other year shows an increase, and on the whole there was a marked increase in the period 1884 to 1891. Even the reduced production of 1893 (as compared with 1891) is nearly double that of 1884.

Nor is it true that the production of the two chief grades of oil, that is, the sandstone oils of the Appalachian region and the sulphur-bearing limestone oils of Western Ohio and Indiana, shows any steady decline. The production of the sandstone oils of the Appalachian district in 1893 was 31,362,890 barrels, as compared with 23,953,090 barrels in 1884. Surely not a steady decline. The production of these oils did decline from 1886 to 1888, but in 1889 it began to increase, and in 1891, the year of McDonald, it was, by some 5,000,000 barrels, the largest ever known.

A somewhat similar state of facts may be pointed out as to the limestone oils of Ohio and Indiana. From 1886, when the production of this oil began to assume importance, up to 1891, the production had steadily increased from 1,064,025 barrels to 17,452,602 barrels, and even in 1893 it was 15 times what it was in 1886.

If Mr. Goulishambarow means that the proportion of the production of sandstone oil, which was practically the only crude produced in the United States in 1884, to the total production has declined, it is a fact, but one of no possible significance, as the absolute production of this sandstone oil has increased. Besides, no limestone oils were produced in 1884.

Even Mr. Goulishambarow's own figures, given above, do not bear out the claim that there has been a steady decrease in production in these years, as they show that the production increased from 3,074,362 tons in 1884 to 6,892,098 tons in 1891, or more than double, and to 6,145,792 tons in 1893, the last year for which he gives production, still more than double. It is possible that Mr. Goulishambarow means that relative to the total production of Russia and the United States, the percentage of the latter has declined. If this is his meaning he is correct, as will be seen from the following table giving the production of the United States and Russia in barrels of 42 gallons. The original figures of Russian production were given in pouds. We take the statement of the Council of the Congress of Russian Petroleum Producers, and on the basis that the average gravity of the Russian oil is 0.875, assume that a barrel of 42 American gallons contains 10.18 pouds.

Production of Crude Petroleum in the United States and the Baku (Russian) Oil Fields, 1884 to 1894, barrels of 42 gallons.

	United States.	Baku.
1884	24,218,438	8,811,000
1885	21,847,205	11,394,000
1886	28,064,841	14,734,000
1887	28,278,866	16,208,000
1888	27,612,025	18,860,000
1889	35,163,513	20,137,000
1890	45,822,672	23,477,000
1891	54,291,980	28,290,000
1892	50,509,136	29,273,000
1893	48,412,666	33,104,126
1894	49,344,516	31,486,740

From the table, which includes the production for 1894, it will be seen that Russia's proportion of the total production of the two countries has advanced from about one-third to about three-eighths, or roughly, in 1884 Russia produced about one-third as much as the United States, while in 1894 it produced more than three-fifths as much. There has been a steady decline, therefore, in the United States' relative proportion of the total production of these two countries in the 10 years—1884 to 1893—and it is only in this sense that there has been a steady decline.

As to Mr. Goulishambarow's statement that the quality of American crude has deteriorated, if this statement refers to the over 30,000,000 barrels of crude produced in the Appalachian field during each of the last five years covered by the last table, the statement is incorrect. In no material sense does the crude produced in the Appalachian field in 1893 differ from that produced in the Pennsylvania and New York field in 1884. It is true, however, that in some respects the limestone crude of Ohio and Indiana is not as good as the crude of the Appalachian fields, but this inferiority is chiefly in the lower percentage of illuminating oil yielded by the limestone crudes, and in the somewhat more difficult process of refining in order to remove the sulphur compounds. When this limestone oil is refined by the methods in use by the Standard Oil Company, the refined oil produced is a better illuminant than that made from the sandstone oils of the Appalachian field. The writer of this speaks with assurance on this point as the result of the experience gained as the member of the mining jury at the World's Columbian Exposition in 1893, who had charge of the examination of the petroleum exhibited. The illuminant from a portion of the Lima field was shown by actual test to be 12 to 15 per cent. better than that from the Appalachian field. The percentage of the yield of illuminating oil from the limestone crude was not as great as from the sandstone crude, and in this respect the former was not as valuable as the latter, but if the former gives a better illuminant it can hardly be said to have deteriorated in quality, though because of its reduced yield it would be less valuable to the refiner.

On any basis the entire American production, or at least the crude of the Appalachian and Lima-Indiana fields, and from these two fields comes fully 98 per cent. of the total production of the United States, is far better as a producer of illuminating oils than the Russian crude. Not only is the quality of the illuminant better, but the crude yields a larger percentage of illuminants. The actual yield of Russian crude is some 35 per cent. of illuminating oil; of the Appalachian at least 75; and of Lima, 38 per cent. to 40 per cent. So that on the basis of illuminant produced, 1 barrel of Appalachian crude would be worth at least 2½ barrels of Russian oil, and of Lima at least barrel for barrel. The total Russian production in 1893, therefore, would yield in round numbers, 10,000,000 barrels, of 42 gallons each of refined, while the Appalachian crude would yield in round numbers, 24,000,000 barrels, the Lima-Indiana, 6,000,000 barrels, and the crude of the rest of the country, 250,000, a total of 30,250,000 barrels illuminants, as compared with 10,000,000 barrels from Russia. That is, measured in illuminants, the production of Russian is only ⅓ that of the United States, instead of ⅔ as measured in crude.

As to Mr. Goulishambarow's prediction that in the near future Russia will vanquish the United States. It is somewhat risky to prophesy. Just before McDonald was struck one of the most intelligent and well informed geologists of the Pennsylvania survey predicted that no more large oil pools would be found in the United States, and almost before the ink in this forecast was dry, McDonald was struck, and the year of the largest production was upon us. At any rate the returns of our exports do not yet indicate defeat, as the table of exports published in our issue of June 17 showed. With the exception of residuum, the exports

of various forms of oil were greater in 1894 than in 1890, as will be seen from the following condensation of the larger table then published.

Exports of Mineral Oils from the United States for the Fiscal Years 1890-1894, *in gallons.*

	Crude.	Naphtha.	Illuminating.	Lubricating.
1890.....	95,450,653	12,937,433	523,295,090	30,162,522
1891.....	91,415,095	12,171,147	571,119,805	33,514,730
1892.....	103,592,767	12,727,978	564,896,568	33,651,076
1893.....	111,703,508	17,304,005	642,239,816	32,432,857
1894.....	121,926,349	15,555,754	730,368,626	40,190,577

An increase of exports of nearly 28 per cent. of crude, of 25 per cent. of naphtha, of 40 per cent. of illuminating, and 33⅓ per cent. of lubricating, in these five years, does not look like defeat.

It does not appear, therefore, that any of the conclusions of Mr. Goulishambarow are justified by the facts, and yet Russia is an oil producing country that must be reckoned with. It has vast deposits of oil, and it will more and more encroach on the markets that are now so largely held by the United States. A fair and wise arrangement between the American and Russian producers is much better for all concerned than a reckless cutting of prices. Russia has vast fields yet undeveloped, as Mr. Goulishambarow points out. The new Russian oil fields in Gronoi and Siberia are of great promise, while along the line of the Transcaspian Railroad several oil fields have been found. How much those will influence the consumption of the world, only the future can tell.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

On August 30th a fire broke out in the purifying room of the Aberdeen (S. Dak.) Light and Fuel Company's works. Well-directed effort on the part of the local firemen kept the loss down to less than $1,000.

The Catskill (N. Y.) Gas Company is putting up a new office building, in which the local electric lighting concern will also share.

Two charging machines of the Brouder type—the basis of which is the Ross charger—are to be placed in the retort houses at the Point Breeze station of the Philadelphia gas works. If their operation proves successful (and it is almost a certainty that such will be the case) the machines will be installed in all the retort houses of the Philadelphia plant. The discharging machines in use are giving unqualified satisfaction.

Papers incorporating the American Incandescent Gas Company, with headquarters at Kansas City, Mo., have been filed. Its objects as stated are "the manufacture and distribution of gas and electricity for lighting, heating and motive power." The capital stock is put at $1,000,000, and Mr. Thomas Hennessey, of Grand Falls, S. Dak., is one of the incorporators. At the organization meeting of the Company the following officers were chosen: President, A. E. Stillwell; First Vice-President, J. McD. Trimble; Second Vice-President, Ira C. Hubbell; Third Vice-President, J. de Goeijen, Jr.; Secretary, Robert B. Cone; Treasurer, William S. Taylor; Assistant Secretary and Treasurer, Frank B. Wilcox. The American Incandescent is, beyond a doubt, well supplied with executive managers.

The shareholders in the Mendota (Ills.) Gas Company and the Mendota Electric Light Company have voted to consolidate their interests. The consolidated enterprise is to be known as the Mendota Light and Heat Company.

The following circular (for a copy of which we are indebted to Mr. John D. McIlhenny) fully explains the situation at Terre Haute, Ind.—the concession is binding upon the Citizens Gas and Fuel Company, too:

"The Terre Haute Gas Light Company hereby notifies the consumers of gas of an increase in gas rates after the August registration. The Company realizes the fact that gas has been sold in Terre Haute at a very low figure, and in deference to this and to the desire to place gas in reach of all for all purposes, the scale adopted is the lowest of any Company in the United States, and is as follows:

"All bills will be made out at $1 per 1,000 cubic feet; but on all bills paid at the office of the Company by the 10th of each month, discounts will be allowed of—

10 cents per 1,000 cubic feet on bills under 1,500 cubic feet per month, or 90 cents net.

15 cents per 1,000 cubic feet on bills between 1,500 and 3,000 cubic feet per month, or 85 cents net,

20 cents per 1,000 cubic feet on bills between 3,000 and 5,000 cubic feet per month, or 80 cents net.

25 cents per 1,000 cubic feet on bills of 5,000 cubic feet or over per month, or 75 cents net.

"It may be said that the gas business is much like any other business, and the same business principles must be employed as in any other manufacturing enterprise. It is felt that the consumers and citizens of Terre Haute will appreciate this fact, and neither expect nor desire the Gas Company to give them anything for nothing, or at a loss.

"It is a well known fact that when companies or individuals are not making or are losing money they will economize in every possible direction, cut off labor, reduce wages and render inefficient service. On the other hand, when a company or individual is fairly prosperous they will be more liberal and be a practical and positive benefit to any community. This the Terre Haute Gas Light Company will endeavor to be.

"The prices adopted will, no doubt, be satisfactory to the consumer, as the amount of money paid for gas in a year is relatively small. From an examination of the records of the Company it is found that not more than 5 per cent. of the whole number of consumers have paid bills averaging $5 per month or more. Also, from the records and estimating gas at 90 cents per 1,000 cubic feet, the average daily cost of gas to more than half of the whole number of consumers will amount to but 4½ cents per day, which is less than the cost of an ordinary cigar or a single street car fare. It is doubtful if any other household expenditure is so light or brings such a return. Gas is always ready for use, night or day, can be used for illumination or for fuel, is valuable in the sick room, and its use is attended with no danger of explosion.

"It is the experience in all business that the customers are apt to remember only the largest bills paid. Such is the case with gas consumers, it being very natural to forget that small bills are paid in warm months of the year. When expenditure of money is made in small sums at a time, 5 or 10 cents a day, very few ever count up the total at the end of the month. What person knows the aggregate paid a month for car fare, which amounts to quite a sum, but is willingly and well spent?

"There are very few people in Terre Haute who cannot afford to spend for gas even more than 5 to 10 cents a day, but all desiring to economize are invited to use Welsbach lights. Burning but 3 feet an hour, half as much as an ordinary jet, is equivalent to reducing gas one-half in price, or from 90 cents to 45 cents per 1,000 cubic feet, giving at the same time 60-candle power, or three times as much light, is equivalent to gas at 15 cents per 1,000 cubic feet. In other words, one Welsbach light using 3 cubic feet of gas gives as much light as 18 cubic feet of gas burned ordinarily. The Welsbach lights can be seen and are for sale at the office of the Company. It is the purpose of the Company to supply the best gas that can be made and to render satisfactory service to all consumers and asks to be informed of any inadequacy of supply or service. Burners and lava tips will be furnished free upon application.

"A word to those who have heretofore used gas, either for principal or auxiliary heating. The Gas Company, with the more modern methods that will be employed for manufacturing gas, asserts that under the improved methods there will be a decided economy as to the better quality and quantity used; and to those using gas stoves for heating purposes it may be said that with the improved methods and quality it is likely that the cost of operating these stoves will be little, if any, more than in the past.

"It is therefore, urged that those who have been users of gas for cooking and general heating purposes make careful test as to the economy of gas, rather than make reckless disposal of gas stoves, before determining this important question to their own satisfaction."

The Troy (N. Y.) *Press* says that during the time set for hearing grievances by the general assessors a representative of the Troy Gas Company appeared before them and produced evidence to show that the Company was improperly assessed on personal property to the amount of $540,800. The assessors decided to remove the figures; but it has been found that they failed to do so, for the books have been confirmed and turned over to the Comptroller, with the figures originally named standing thereon. The Company now has no remedy save through instituting court proceedings for the rescinding of the assessment. The payment involved amounts to about $7,000.

The works of the Bronx (N. Y.) Gas and Electric Company are well along towards completion.

The celebrated financier who is said to control the remains of the gas works constructed some time ago in the vincinity of Cooper's glue

factory—the fanancier's name is B. I. H. Trask, and the name of the gas works is Equity, and the location thereof is Maspeth and Porter avenues, Brooklyn, N. Y.—recently convened a special meeting of the shareholders for the purpose "of readjusting the official management thereof." The result reached was: Directors, John C. Voorhees, Edward Dodd, Frank N. Dodd, George F. D. Trask, Franklin Everhard; President, B. I. H. Trask; Secretary, Geo. W. Pinchbeck.

THE W. J. McClurg Gas Company, of Pittsburgh, Pa., has applied to the authorities for the right to lay pipes through the streets and alleys of Homestead, Pa., for the distribution of gas in and around the locality named.

THE authorities of Athens, Ga., have been dickering with the Athens Gas Light Company for the purchase of the latter's arc and incandescent annex, and the appraiser appointed to determine the value of the said plants (the appraiser acted for the city) reported their worth at $11,000. The Company's appraiser values the plants at $18,000.

THE *Daily Fredonian*, of New Brunswick, N. J., says: "The local Gas Company has placed, on the corner of Church and George streets, a double Welsbach lamp, of 60-candle power each, making 120-candle power combined, according to the legal standard of light. Many people do not know what the term candle power means; the legal standard for gas light is the light produced by a sperm candle, consuming 120 grains of sperm per hour. This is the law of the State of New Jersey, and pertains to every State in the Union and throughout the world where gas is used. There is no legal standard for any other kind or description of light whatever, so that any other light can claim any 'highfalutin' rating of candle power it pleases, without any compunctions of conscience. The laws of New Jersey provide a penalty of $100 per day for the sale and distribution of illuminating gas, 5 cubic feet of which produce a less light than 14-candle power according to the above standard."

THE Messrs. Wm. M. Crane & Co. are in the field with their catalogue of gas heating stoves for the season of 1895–1896. It is well put together, and he would indeed be a dullard who could not order from it understandingly.

THE plant of the Darby (Pa.) Gas Company has been purchased by the Delaware County Gas Manufacturing Company.

THE artesian well recently drilled on the premises of and to the order of the Waltham (Mass.) Gas Light Company is 8 inches in diameter and 300 feet deep, and can be depended on to yield 108,000 gallons every 24 hours. The contractors were Messrs. B. F. Smith & Brother, of Waltham.

THE Putnam (Conn.) Light and Power Company is making important improvements on its plant this season, not the least of which is a storage holder rated to contain 40,000 cubic feet. The main system was increased by the placing of about 3¼ miles of pipe.

LAST month the gas supplied by the Brockton (Mass.) Gas Light Company averaged 18·9 candles in illuminating value, as per the State Inspector's report.

THE new holder for the Keene (N. H.) Gas Light Company is being constructed by Messrs. Deily & Fowler, of Philadelphia.

THE Los Angeles (Cal.) *Times* says that Mr. A. B. Williams, Manager of the Santa Barbara (Cal.) Gas Company, has entered into a contract with Mr. O. N. Guldlin, of the Western Gas Construction Company, under which the latter will instal at Santa Barbara a water gas plant of the Construction Company's well known type. The apparatus will be placed in a substantial brick and iron building, to be erected at the corner of De la Guerra and Santa Barbara streets, and a new holder figures in the betterments. The work will be completed in November, at an estimated expenditure of $50,000, and is to be under the advisory direction of Mr. E. C. Jones, of the San Francisco Gas Company.

ARTICLES incorporating the Kansas City (Mo.) Gas Company, as the successor of the Kansas City Gas Light and Coke Company, have been filed. The capital stock is $2,500,000, of which one million is preferred stock and the balance is common. The preferred stock is in the name of Lewis C. Lillie, of Philadelphia, who also holds 14,970 shares of the common. George S. Philler, of Philadelphia, and John C. Gage, E. L. Martin, M. J. Payne, J. T. Holmes and C. E. Small, of Kansas City, own five shares each of common stock. The articles name 50 years as the life of the Company, and also accept the Councilmanic measure known as the dollar gas ordinance.

THE following is the text of the opinion handed down by the Corporation Counsel of Cincinnati (Mr. Fred. Hertenstein), in the matter of the contention between the authorities of Cincinnati and the Cincinnati Gas Light and Coke Company, as to the price the latter was entitled to charge for gas:

To the Honorable the Board of Administration: Gentlemen—I return herewith the bills of the Cincinnati Gas Light and Coke Company for light furnished during the month of July, 1895. The light is furnished to the city by the Gas Company in pursuance of the Conover contract, which provides that, "in consideration of the privileges hereby granted to the said Conover, his associates, their heirs, assigns or successors, they, the said Conover, his associates, their heirs, assigns or successors, shall furnish to the city, on the several streets, lanes, commons and alleys in which the leading or main pipes for supplying the citizens with gas light shall be laid and in use, such quantity of gas as may be required by the City Council for public lamps, at two-thirds of the lowest averaged price at which gas shall or may be furnished to private individuals in the cities of New Orleans, Baltimore, New York, Louisville and Pittsburgh, the lamp posts, connecting pipes, meters and lamps being furnished by and at the expense of said city." A controversy arose between the city and the Gas Company as to the proper construction of this clause of the contract, and in order to obtain a decision of the courts upon the proper interpretation thereof, the Board of Administration rejected the bills for the months of May and June, 1890, and thereupon the Company instituted an action for the recovery of the amounts of said two bills. The Supreme Court held that the clause referred to means the lowest cash price, in each city, at which gas shall or may be furnished to private individuals, averaged by adding together such lowest cash prices, and dividing the amount by five, and two-thirds of the quotient will be the price to be paid by the city to the Gas Company. The lowest averaged price stipulated for in the contract entitled the city to the benefit of such discounts as are or may be allowed to individuals by the Company in each city, furnishing gas at the lowest price. It will be observed that the lowest average price is made up by taking the lowest price at which gas shall or may be furnished to private individuals in each of the five cities named, deduct therefrom the discount allowed consumers, then add up the net prices thus obtained in said five cities, divide by five, and two-thirds of the quotient will be the price that the city must pay the Company. The bill for May, 1890, was $12,113.99, and that for June, 1890, was $10,940.20; total, $23,054.19. Applying the rule stated, the Company is entitled to $11,631.19 for the month of May, 1890, and to $10,523.70 for the month of June, 1890; total, $22,154.89. The Company is also entitled to interest on this amount at the rate of 6 per cent. per annum until paid, and the principal and interest to July 1, 1895, aggregate $28,859.51, for which I will permit a judgment to be entered against the city this week, so that the same may be paid by the sinking fund trustees at their meeting in September, and I do this in order that the interest may cease. This judgment bears interest from the 1st of July until the same is paid. It appears that all the bills since the rejection of these two bills have been paid by your Board, with the following proviso: "Upon condition that it shall in no respect affect any claim by either party concerning any matter now in dispute, in relation to the proper construction of the clause in the contract with regard to the charge for gas." The Supreme Court held that these payments so made, upon the conditions stated, were voluntary, and that there cannot be a recovery back for amounts paid over and above those that the city was compelled to pay. As to the unpaid bills, the bills in question, and all those that may be rendered hereafter, you will follow the rule laid down by the Supreme Court, to wit: Take the lowest price at which gas shall or may be furnished to private individuals in each of the five cities named, deduct the discount allowed consumers, which will give you the net price for each city, then add up these net prices of the five cities named, divide the sum total by five, and two-thirds of the quotient will constitute the price that the city will have to pay for gas.

SOME days ago a special committee (Messrs. O'Brien, Norris, Caddigan, Crocker, Riddel, Berwin and Jones) of the Boston City Council, appointed under a legislative order entitled "An Act to enable cities and towns to manufacture and distribute gas and electricity," left Boston for the purpose of visiting New York, Philadelphia, Baltimore, Washington, Richmond, Pittsburgh, Buffalo, Niagara Falls, Cincinnati and Chicago, with a view to acquiring information regarding municipal lighting. It is a junketing trip, merely.

THE Milwaukee Gas Light Company is furnishing gas to 2,642 public gas lamps, at the rate of $22 each per annum.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

MONDAY, SEPTEMBER 9, 1895.

Brickdust Mortar.

The use of brickdust mortar as a substitute for hydraulic cement, where the latter cannot be obtained, is now recommended (the *Southern Architect* says) on the best engineering authority; experiments made with mixtures of brickdust and quicklime showing that blocks of ½ inch in thickness, after immersion in water for four months, bore without crushing, crumbling or splitting, a pressure of 1,500 lbs. per square inch. It is considered, too, that the addition of even as small a proportion as one-tenth as much brickdust as sand to ordinary mortars is preventive of the disintegration so often characterizing mortars used in the masonry of public works. The use of brickdust mixed with lime and sand is said to be generally and successfully practiced in the Spanish dominions, and is stated to be in all respects superior to the best Rosendale hydraulic cement in the construction of culverts, drains, tanks or cisterns, and even roofs, whether for setting flat tiles or for making the usual tropical flat roof. The proportions used there in the manufacture are, approximately, one of brickdust, one of lime, and two of sand, mixed together dry and tempered with water in the usual way.

Purification of Petroleum.

R. Zaloziecki says it is known that in washing petroleum distillates with sulphuric acid the concentration and purity of the acid have an important effect on the quality of the refined product, but the question of temperature, which the author considers of equal moment, does not appear to have received proper attention on the part of chemists.

The best results are invariably obtained by conducting the acid washing process at as low a temperature as possible. The author worked at temperatures ranging from 0° to 25°, and obtained whiter and purer products the more closely he approached the lower limit. Working under identical conditions as to concentration and purity of acid, the distillate obtained after the acid treatment at 25° had a distinct yellow color, while that following an acid treatment at 0° was almost colorless, with simultaneous diminution of the difficulties accompanying the process of purification, *i. e.*, at the lower temperature the rate of clarification increased with the yield of refined product.

The action of sulphuric acid on petroleum is of twofold character: (1) Elimination and solution of impurities. (2) Oxidation of the heavier portions. Although the rate of absorption is not materially influenced by slight variations of temperature, the oxidation increases rapidly with a rise of temperature, as is evinced by the copious evolution of sulphurous anhydride. Moreover, at a higher temperature, the solvent properties of petroleum for resin acids, and more especially for oxidation products, increases, the result being the contamination of the distillate with impurities, which it is impossible to completely remove either by washing with soda lye and water or by other means.

Smoke Prevention.

The serious difficulty with nearly if not quite all the appliances which have been devised for consuming smoke is that they do not pay. The heating capacity of smoke is so little that it is cheaper to waste the smoke than to utilize the small amount of potential heat there is in it; besides this, some portions of the smoke are incombustible. Colonel Dulier has devised a system of smoke prevention, which has been described in the London *Times*, by which the smoke after leaving the furnace is mixed with steam in an ascending flue, and then in a descending flue is met by a very fine spray of cold water. The result is that the larger part of its constituents are dissolved or precipitated and escape with the water into the drains, from a tank at the bottom of the descending flue. Any residue passes out with a certain amount of steam from a chimney fixed in the tank. A rough proof of the efficacy of the arrangement is afforded by the fact that a piece of white cloth may be held for some minutes over the top of this chimney without becoming appreciably blackened.

Colonel Dulier's apparatus is in use at the City Saw Mills, Glasgow, and at Messrs. Merryweather's factory at Greenwich, and is being fitted to the Opera in Paris. At Messrs. Merryweather's the smoke from 11 forges is collected in one main flue, and after being mixed with steam is subjected to the action of three water jets consuming 100 gallons of water an hour. The system is here found so satisfactory that the rest of the forges are shortly to be connected, and it is considered that the same amount of water will be sufficient to treat the smoke from them also. From observations made by the Public Analyst of Glasgow at the Saw Mills, it appears that the apparatus there removes over 90 per cent. of the solid matter of the smoke and more than half the sulphurous acid. It does not affect the draft in the chimney, any loss caused by the bends of the flues being compensated by the effects of the jet of steam which damps the smoke. In Glasgow this jet is at a pressure of 80 pounds to 100 pounds per square inch, but though a fairly high pressure both for the steam and water jets seems to be advantageous, yet it is not necessary.

The apparatus has been fitted to a stack of chimneys in a house in Belgravia, and has worked satisfactorily, using the water from the mains, and the steam given off by an ordinary high pressure hot water boiler. It is even said to have resulted in a reduction in the amount of coal burnt. There is an incidental advantage connected with it which may commend itself to people who are solicitous about sanitation. The water which has been used in the flue contains a quantity of sulphurous acid, and is, therefore, a disinfectant of considerable power. The cost of construction ought not to be very great, since the flues are only large steel tubes. But if the apparatus fulfils all that is claimed for it, manufacturers might find themselves recouped for their outlay by being able to burn an inferior and cheaper coal without producing an improper amount of smoke.

The Market for Gas Securities.

The market for Consolidated was active and strong during the week, and the opening to-day (Friday) was made at 145, at which price 100 shares changed hands. The demand on investment account continues, and as a result the supply of floating stock for speculative purposes is being very much curtailed. Even at the risk of incurring the charge of repeating ourselves too often, we advise the purchase of Consolidated at anything under 160. Standard, both common and preferred, shows fair strength, as does Mutual, which is bid for at 172. Equitable is 195 bid, and East River common is unchanged, at 30 bid.

There is no news from Brooklyn, and values, which are nominal rather than real, are as before.

Chicago gas sold up to 65½ during the week, at which figure considerable long stock came out. This realizing forced the price to 63⅜, but to-day the shares are stronger, at 64½. Consumers, of Jersey City, is in demand at 91 bid, and the bonds are strong at par bid. Lacledes are wobbly, with a weakening tendency. It is well to remember that the foreclosure sale of the Huntington (L. I.) works will take place at noon on the 17th inst.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

September 9.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,480,000	100	144	145
Central	500,000	50	150	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	195	..
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,300,000	1,000	113	115
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	172	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	90	91
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	30	31
Preferred	2,000,000	100	54	55½
Bonds	3,500,000	1,000	93½	94
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	67½	..
Preferred	5,000,000	100	108	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109	..
Yonkers	299,650	50	112	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,200,000	20	65	..
" S. F. Bonds	880,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	800,000	..	108	..
Peoples	1,000,000	10	90	.
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	225	..
" Ctfs	700,000	1,000	99	100
Williamsburgh	1,000,000	50	210	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	19	19⅛
" Income Bonds	2,000,000	1,000	23	..
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	..	80
2d " " "	3,000,000	1,000	51	55

Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	.....	..	95	..
Chicago Gas Co.	25,000,000	100	64	64½
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	93	93½
Columbus	1,069,000	..	63	66
1st Mortgage	1,085,000	..	91	98
Consumers. Jersey City	2,000,000	100	91	93
" Bonds	600,000	1,000	100	105
Cincinnati G. & C. Co.	7,000,000	100	208	208½
Consumers, Toronto	1,800,000	50	184½	187
Central, San Francisco	.....	..	95	..
Capital, Sacramento	.....	.	..	41
Consolidated, Baltimore	11,000,000	100	..	62½
Mortgage, 6's	3,000,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	30¾	..
" Con. Bonds	4,312,000	..	75	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	72	74
" Bonds	2,000,000	..	85	..
Hartford	750,000	25	130	135
Indianapolis	2,000,000	..	150	155
" Bonds, 6's	2,650,000	..	105½	..
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind	1,000,000	100	84	86
Bonds	1,000,000	1,000	88	90
Louisville	2,570,000	50	..	180
Laclede, St. Louis	7,500,000	100	27	28
Preferred	2,500,000	100	84	88
Bonds	9,034,400	1,000	97	97¼
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
New Haven	.....	25	225	..
Oakland, Cal.	.....	..	45	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	83	..
Consolidated 5's	2,000,000	..	87¾	90
San Francisco, Cal.	10,000,000	100	71¼	72
St. Paul Gas Light Co.	1,500,000	100	68	70
1st Mortgage, 6's	650,000	..	..	..
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	64½	67
Bonds, 5's	3,556,000	..	95	..
Wilmington, Del.	800,000	50	188	190

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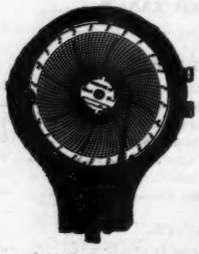

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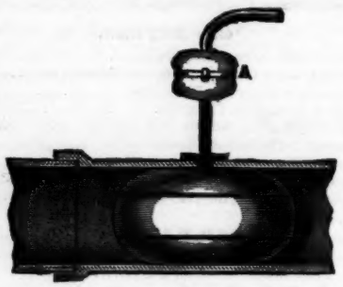

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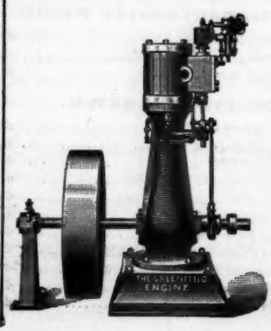

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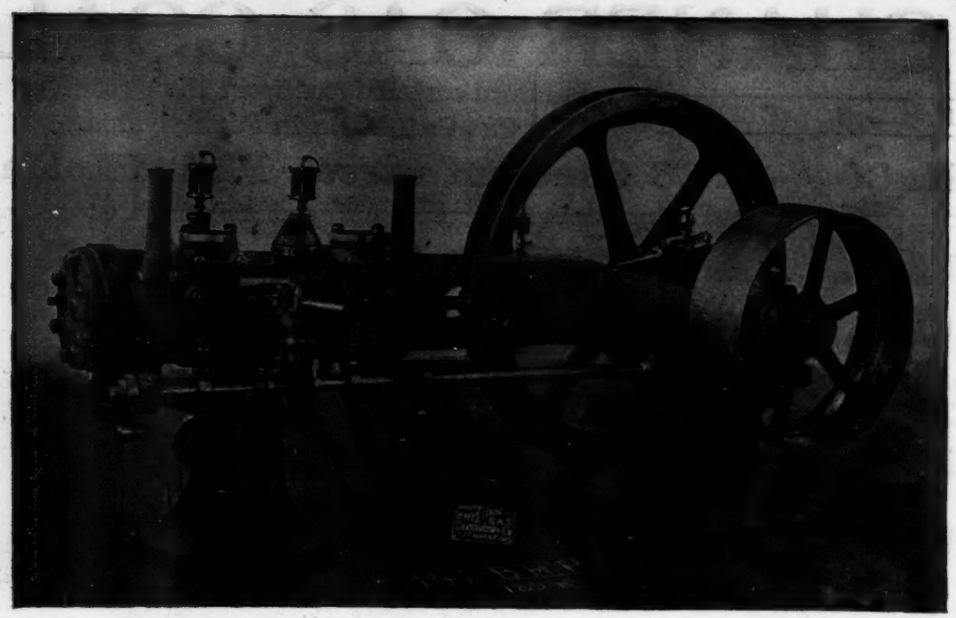

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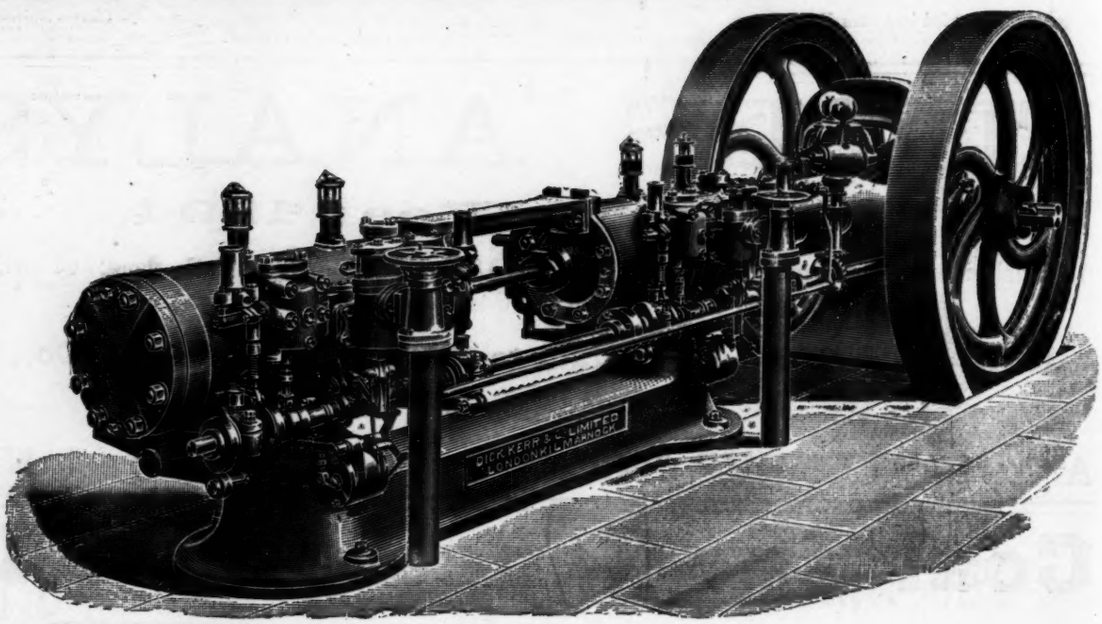

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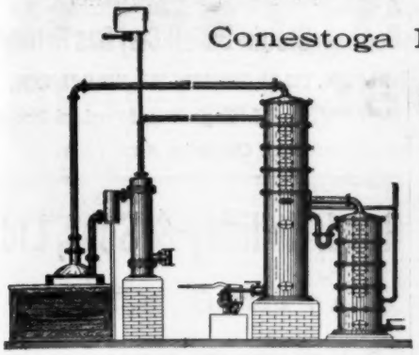

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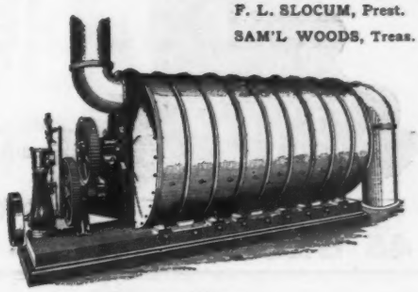

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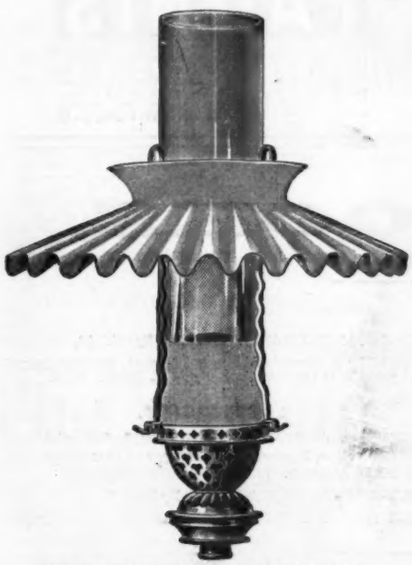

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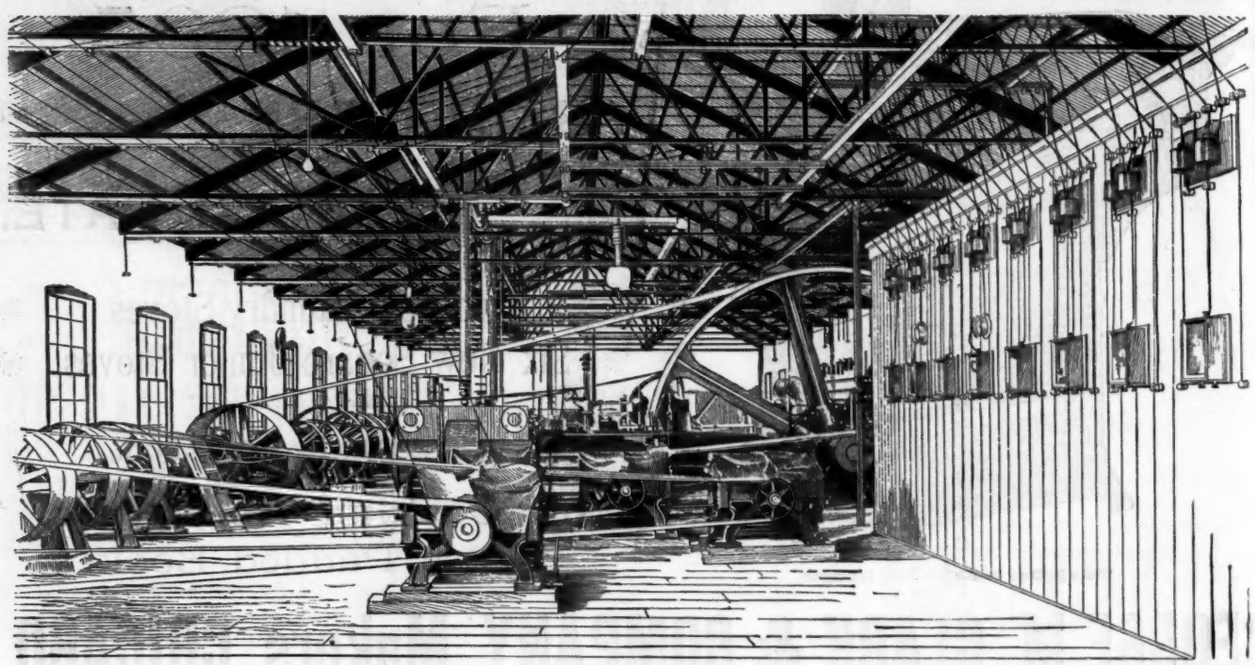

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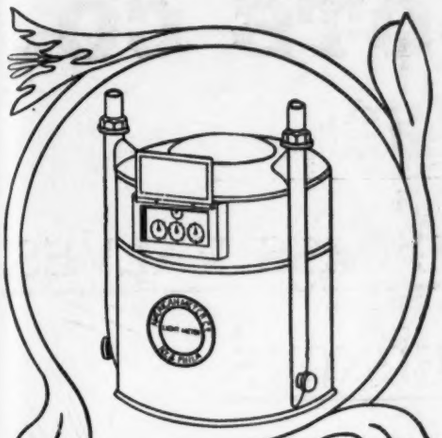

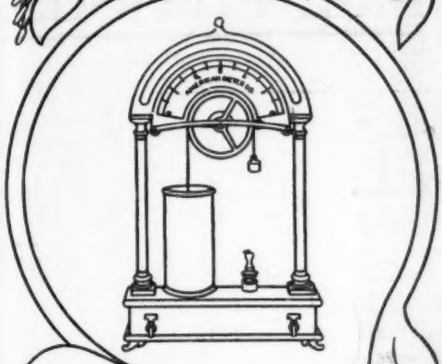

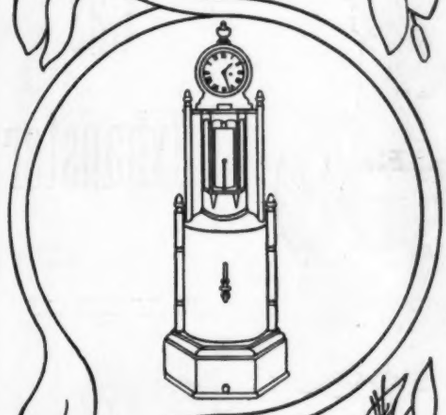

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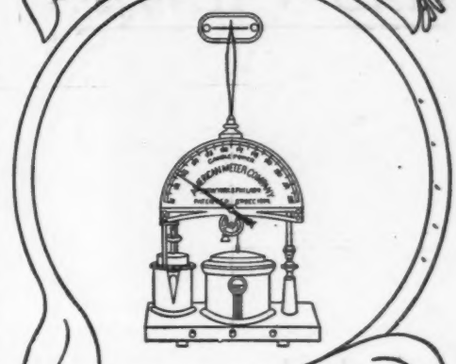
PUBLIC LIGHTING TABLE.

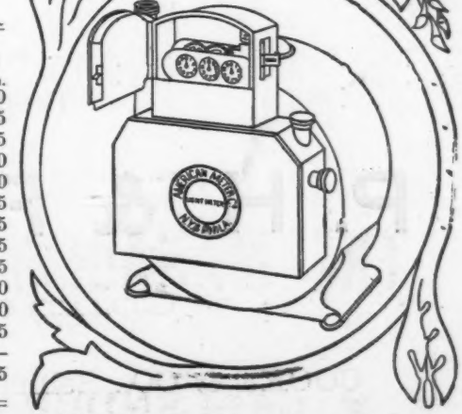
SEPTEMBER, 1895.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	2 40 AM	4.30 AM	6.30	4.20
Mon.	2	No L.	No L.	6.30	4.20
Tue.	3	No L. FM	No L.	6.15	4.30
Wed.	4	No L.	No L.	6.15	4.30
Thu.	5	6.50 PM	8.00 PM	6.15	4.30
Fri.	6	6.50	8.20	6.15	4.30
Sat.	7	6.50	8.40	6.15	4.30
Sun.	8	6.50	9.00	6.15	4.30
Mon.	9	6.50	9.30	6.15	4.30
Tue.	10	6.50	10.10	6.05	4.40
Wed.	11	6.50 LQ	10.50	6.05	4.40
Thu.	12	6.50	11.50	6.05	4.40
Fri.	13	6.50	1.00 AM	6.05	4.40
Sat.	14	6.50	2.20	6.05	4.40
Sun.	15	6.30	4.40	6.05	4.40
Mon.	16	6.30	4.40	6.05	4.40
Tue.	17	6.30	4.40	5.55	4.50
Wed.	18	6.30 NM	4.40	5.55	4.50
Thu.	19	6.30	4.40	5.55	4.50
Fri.	20	6.30	4.40	5.55	4.50
Sat.	21	6.30	4.40	5.55	4.50
Sun.	22	6.30	4.50	5.55	4.50
Mon.	23	7.40	4.50	5.55	4.50
Tue.	24	8.30	4.50	5.40	5.00
Wed.	25	9.30 FQ	4.50	5.40	5.00
Thu.	26	10.30	4.50	5.40	5.00
Fri.	27	11.30	4.50	5.40	5.00
Sat.	28	12.30 AM	4.50	5.40	5.00
Sun.	29	1.40	5.00	5.40	5.00
Mon.	30	2.40	5.00	5.40	5.00

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45





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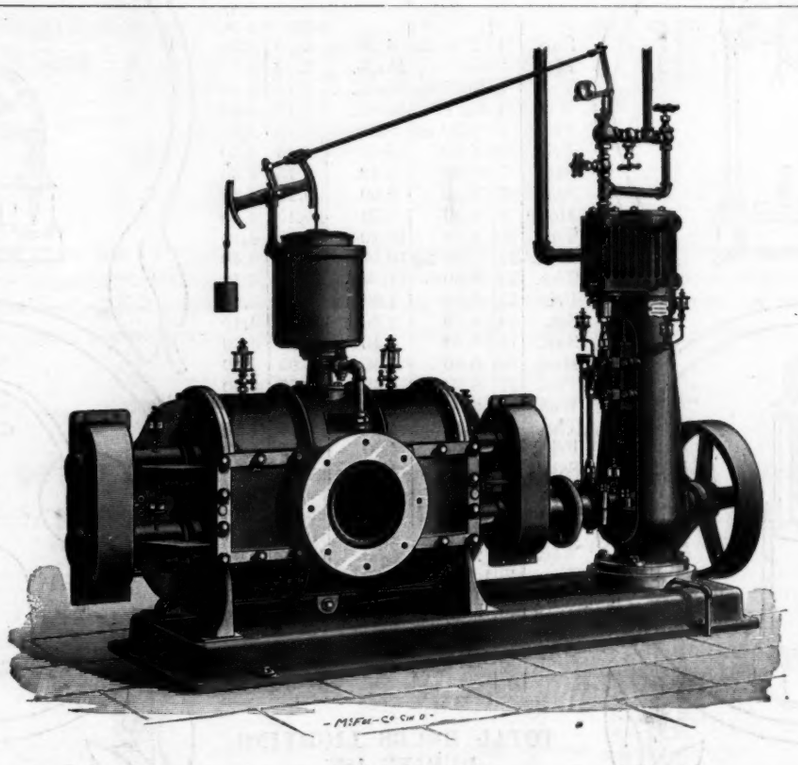

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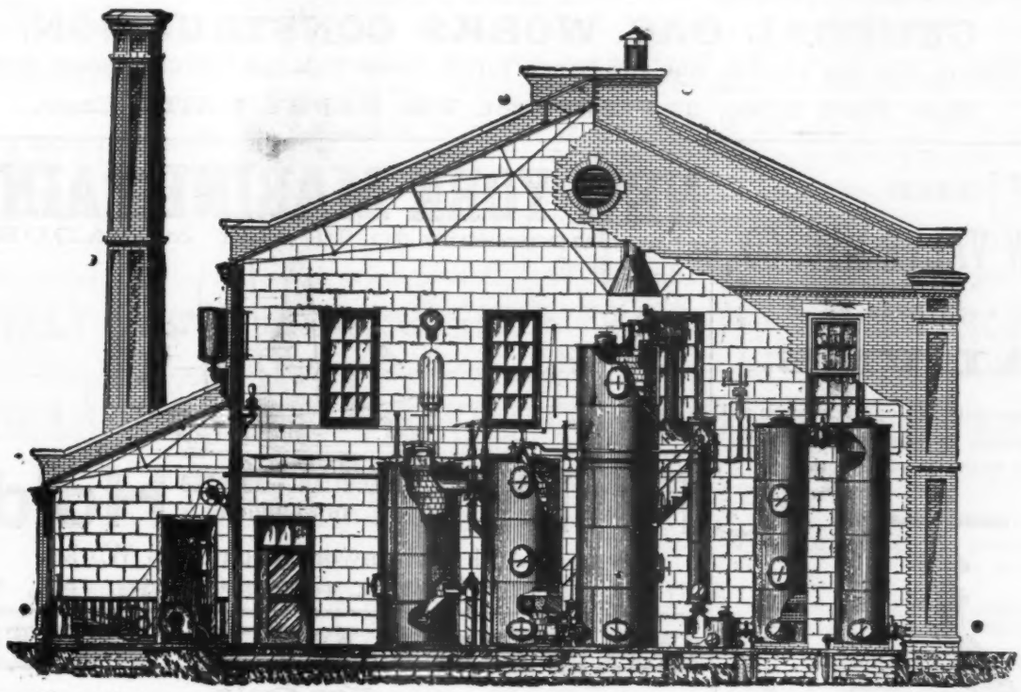

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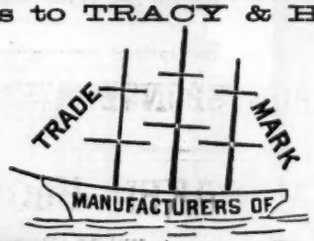

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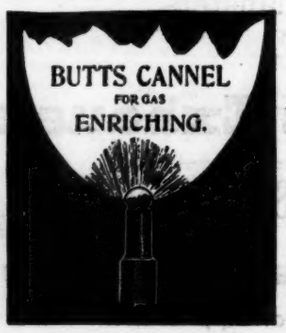

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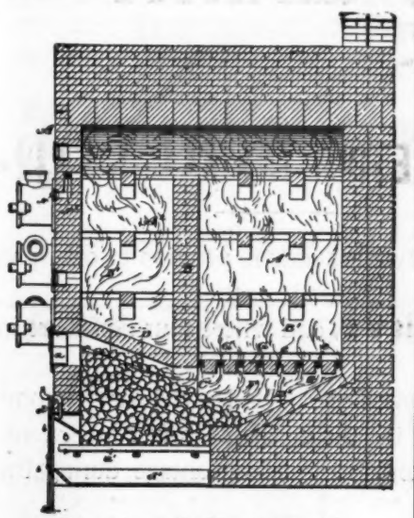

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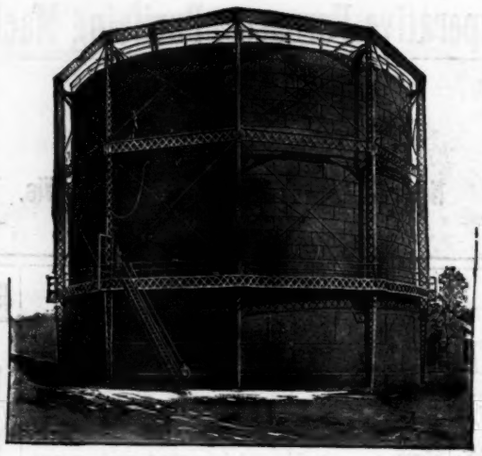

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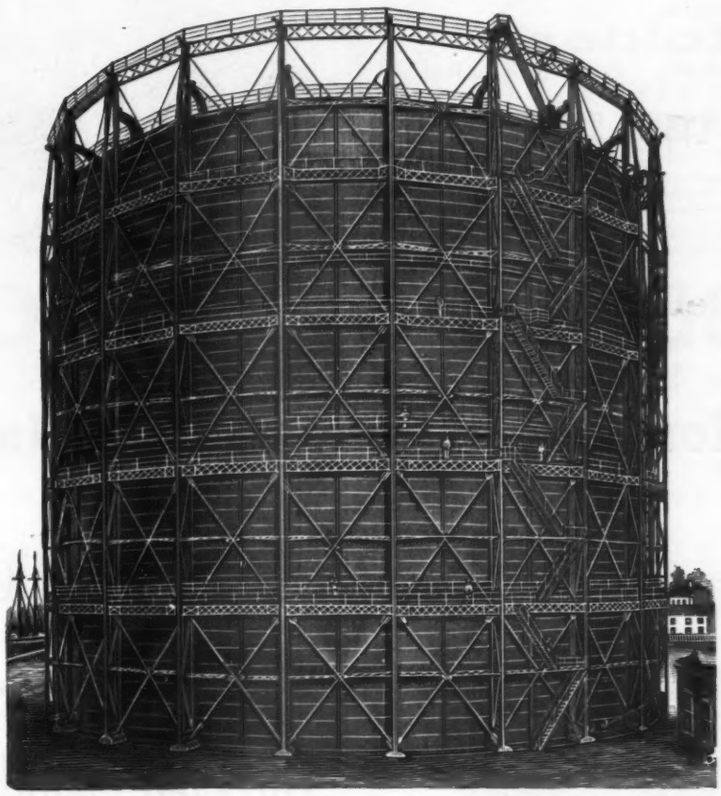

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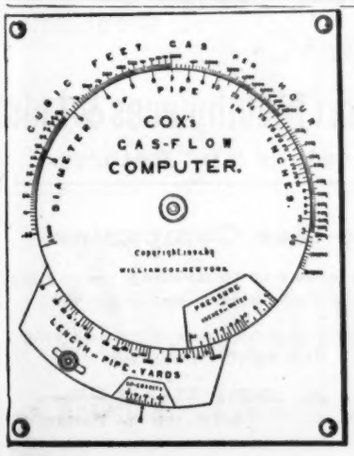

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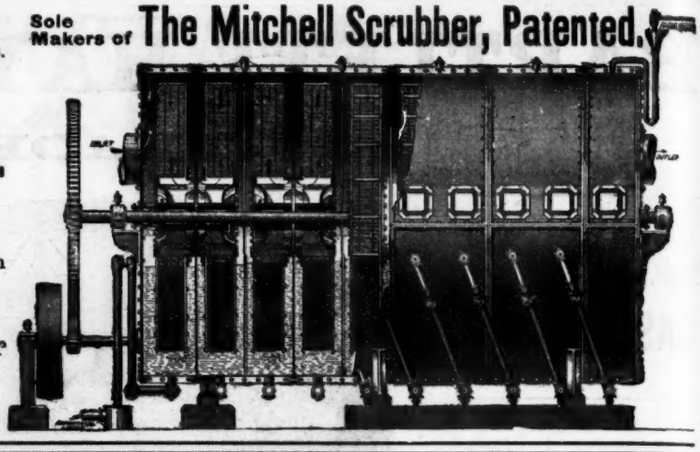

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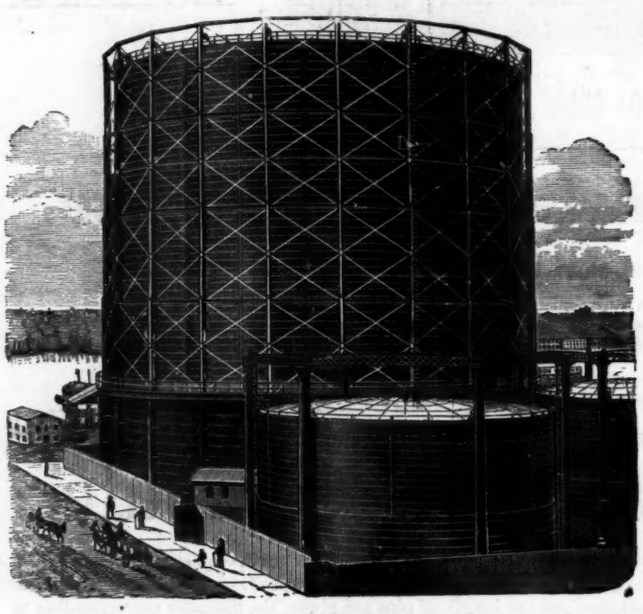

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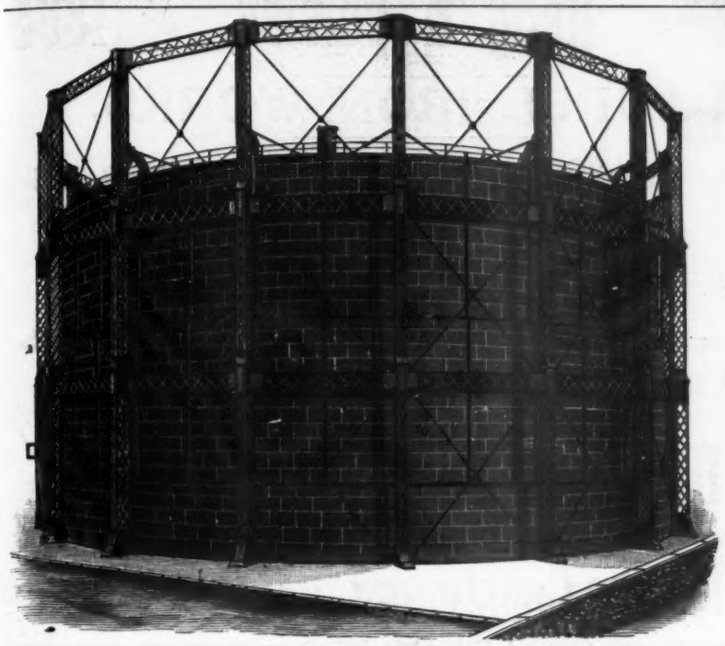

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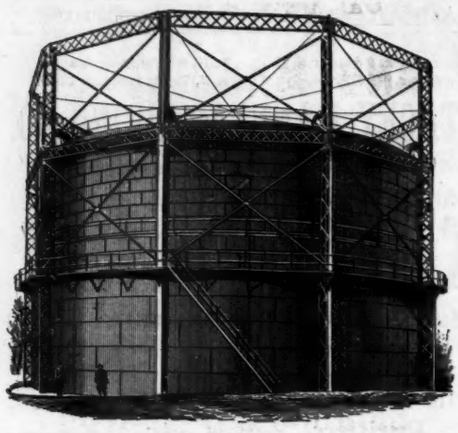

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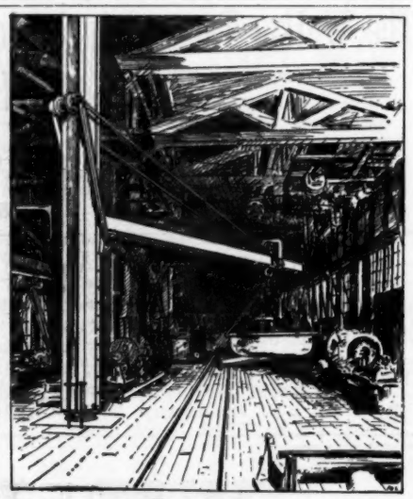

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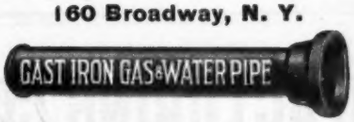

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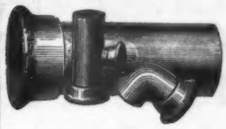

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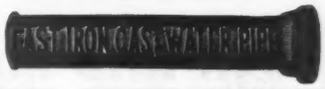

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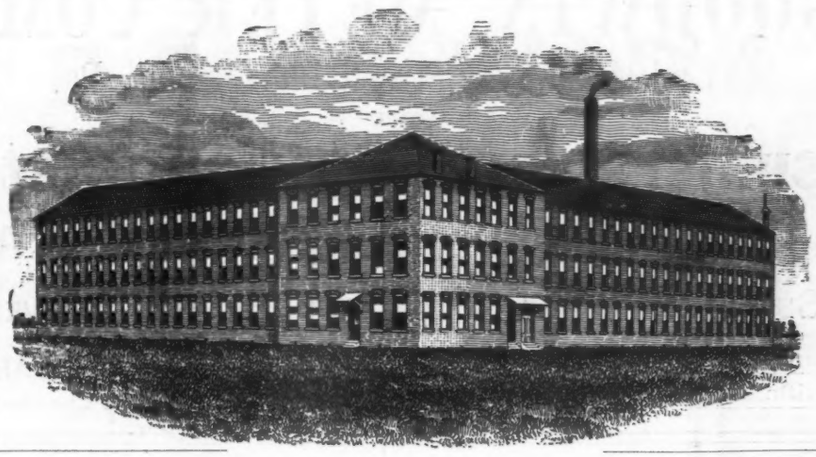

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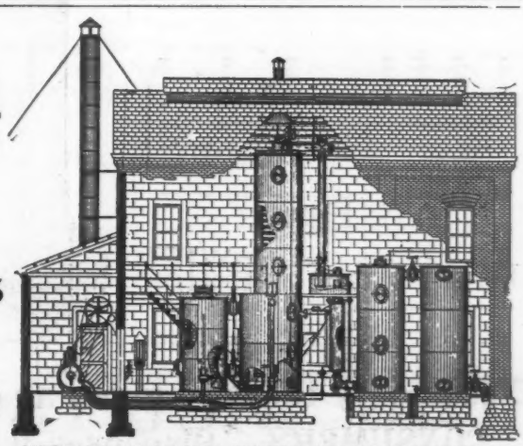

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